JPMHR Journal of Precision Medicine and Health Research

Original Article

Influence of Saddle Design and Riding Posture on the Prevalence of Coccydynia in Motorcycle Riders

Qazi Mohammad Irfan[1], Omer Shujat[2]

[1]Senior Registrar, Sheikh Zayed Hospital, Rahim Yar Khan, Pakistan

[2]University of Lahore, Lahore, Pakistan

***Corresponding author: Qazi Mohammad Irfan, drirfanqazi@gmail.com**

Cite This Article
Qazi Mohammad Irfan and Omer Shujat 2024. Influence of Saddle Design and Riding Posture on the Prevalence of Coccydynia in Motorcycle Riders. Journal of Precision Medicine and Health Research. 1, 2 (Dec. 2024).

Received: 02 July 2024; **Accepted**: 12 October 2024; **Published**: 31 December 2024.
Author Contributions: Concept: QMI; Design: OS; Data Collection: QMI; Analysis: OS; Drafting: QMI, OS.. **Ethical Approval**: Sheikh Zayed Hospital, Rahim Yar Khan, Pakistan. **Informed Consent**: Written informed consent was obtained from all participants; **Conflict of Interest**: The authors declare no conflict of interest.
Funding: No external funding; **Data Availability**: Available from the corresponding author on reasonable request; **Acknowledgments**: N/A.

ABSTRACT

Background: Motorcycle riders are exposed to prolonged static sitting, constrained posture and whole-body vibration, but the specific contribution of saddle design and riding posture to coccydynia is poorly defined. Objective: To estimate the prevalence of coccydynia among motorcycle riders in Lahore and Gujranwala and to identify independent associations between saddle design, riding posture and coccydynia. Methods: In this cross-sectional survey, 300 professional and commuter riders (mean age 32.4 ± 8.6 years; 99.3% male) completed a structured questionnaire and brief ergonomic assessment. Coccydynia was defined as coccygeal pain aggravated by sitting for ≥4 weeks. Exposures included saddle type, saddle tilt, cushioning rating, saddle width, riding posture score, forward trunk lean, daily riding hours, vibration exposure and shock-absorber condition. Group comparisons used t-tests and chi-square tests; associations among continuous variables were examined with Pearson correlations. Multivariable logistic regression estimated adjusted odds ratios (aOR) for coccydynia. Results: Coccydynia prevalence was 36.0% (108/300). Riders with coccydynia had longer daily riding (8.9 vs 6.1 h; $p < 0.001$), poorer posture (7.8 vs 5.6/10; $p < 0.001$), greater trunk lean (34.2° vs 25.4°; $p < 0.001$) and higher vibration scores (8.2 vs 5.9; $p < 0.001$). In regression, daily riding (aOR 1.62 per hour), posture score (aOR 1.86 per point), forward saddle tilt (aOR 3.60), vibration (aOR 1.46 per unit), poor shock absorbers (aOR 2.94) and trunk lean (aOR 1.97 per 10°) independently increased odds, whereas soft foam, gel and ergonomic saddles reduced odds by 76–94% ($p \le 0.001$). Conclusion: Saddle design, saddle tilt and forward-leaning posture are major modifiable contributors to coccydynia in high-exposure motorcycle riders. Ergonomic and physiotherapy-based interventions targeting these factors are strongly warranted. Keywords: coccydynia; motorcycle riders; saddle design; riding posture; vibration; logistic regression.

INTRODUCTION

Motorcycle use has increased dramatically in South Asian megacities, where two-wheelers are the primary mode of transport for both commercial and personal mobility, exposing riders to prolonged static sitting, constrained postures, and whole-body vibration in dense traffic and poor road conditions (1,2). Cross-sectional surveys among two-wheeler riders consistently report a high burden of musculoskeletal disorders, particularly in the lumbar spine, neck, and shoulder region, with substantial associated functional limitation and work disability (1,3). Within this broader spectrum of riding-related pain syndromes, the coccyx represents a critical yet under-recognised load-bearing structure because it forms part of the seated tripod along with the ischial tuberosities and transmits repetitive compressive forces during riding over uneven surfaces (4,5).

Coccydynia, defined as pain in or around the coccyx aggravated by sitting or transitions from sitting to standing, is an uncommon but potentially disabling condition that can markedly impair activities of daily living and occupational performance (4,6). Narrative and systematic reviews emphasise that female sex, obesity, trauma, childbirth, abnormal coccygeal mobility and repetitive micro-trauma from prolonged sitting or high-impact activities are important risk factors, yet the true incidence remains poorly quantified (4–6). Prolonged sitting on hard or poorly contoured surfaces increases local pressure on the coccyx and adjacent soft tissues, and clinical resources consistently list long sitting on hard seats, cycling, and other repetitive seated tasks as triggers or aggravating factors for tailbone pain (6,7). Despite these mechanistic insights, most available evidence focuses on clinical cohorts or trauma-related coccydynia rather than occupational or transport-related exposures in healthy populations (4–6).

The ergonomic literature on motorcycle riding shows that handlebar–seat–footrest geometry, trunk flexion angle, and saddle design jointly determine load distribution along the spine and pelvis, with forward-flexed postures and constrained hip angles associated with higher spinal loads and discomfort (2). Cross-sectional and interventional studies among two-wheeler riders have linked long daily riding hours, poor road conditions, and whole-body vibration to low back pain and other musculoskeletal complaints, and suggest that modifications to seat design, lumbar support and riding posture can reduce symptoms (1,3). However, these studies seldom distinguish coccygeal pain from general low back pain, rarely quantify coccyx-specific outcomes, and almost never characterise saddle properties such as material, tilt, and cushioning in a systematic way (1–3). As a result, the specific contribution of saddle design and riding posture to coccydynia in motorcycle riders remains largely speculative.

From a clinical and public health perspective, identifying modifiable ergonomic risk factors for coccydynia is important because most patients can be managed conservatively with a combination of physiotherapy, ergonomic adaptation, seating modifications and analgesia, and conservative strategies are successful in the majority of cases (4,8). If certain saddle features (e.g., hard standard seats, forward tilt, inadequate cushioning) and postural patterns (e.g., excessive trunk flexion, poor global posture) are independently associated with coccydynia, they constitute tangible targets for preventive counselling, motorcycle design improvements, workplace regulations for delivery riders, and physiotherapy-led interventions (4,5,8). Yet, to date, no epidemiological study from Pakistan has examined the prevalence of coccydynia in motorcycle riders while simultaneously modelling saddle design, posture, vibration and riding exposure as potential determinants.

In this context, the present cross-sectional survey was designed to estimate the prevalence of coccydynia among professional and commuter motorcycle riders in Lahore and Gujranwala, and to evaluate the association of saddle type, saddle tilt, cushioning, riding posture and forward trunk lean with the presence of coccydynia after adjusting for riding hours, vibration, shock-absorber condition and basic demographic factors. The primary research question was: among adult motorcycle riders with substantial daily exposure, do saddle design characteristics and riding posture independently influence the odds of coccydynia after controlling for riding duration and mechanical vibration? We hypothesised that hard, forward-tilted saddles, poorer global posture scores, greater forward trunk lean, higher vibration exposure and longer daily riding would be associated with significantly increased odds of coccydynia, while gel or ergonomic saddles would be protective.

MATERIALS AND METHODS

This was an analytical cross-sectional observational study conducted among motorcycle riders in two large urban centres of Punjab, Pakistan. The study targeted riders with substantial daily exposure to road traffic conditions typical of Lahore and Gujranwala, where high motorcycle density, mixed traffic and variable road quality combine to create prolonged static loading, frequent acceleration–braking cycles and repeated shock transmission to the spine. Data was collected over a six-month period using a structured, interviewer-administered questionnaire and brief on-bike assessment. Riders were recruited from delivery services, repair workshops, fuel stations and public parking areas, ensuring inclusion of both professional and commuter riders across a range of motorcycle types.

Eligible participants were men or women aged 18–60 years who had been riding a motorcycle for at least one year, with a minimum average riding time of 2 hours per day on at least five days per week. Riders were excluded if they reported prior major spinal trauma or surgery, inflammatory spondyloarthropathy, diagnosed malignancy, pregnancy, recent pelvic fracture, or any neurological disorder affecting lower limb function, in order to minimise confounding from non-mechanical causes of coccygeal pain. A systematic convenience sampling approach was used: data collectors visited pre-identified high-traffic locations at different times of day and invited consecutive eligible riders to participate until the sample size target was reached. All participants provided written informed consent after receiving information about study aims, procedures, risks and confidentiality. The protocol was approved by the hospital ethics committee, and the study adhered to international standards for observational research and data protection.

The sample size was calculated for estimation of prevalence and for multivariable logistic modelling. Assuming an anticipated coccydynia prevalence of 30% among high-exposure riders, a 95% confidence level and 6% absolute precision, the minimum required sample for prevalence estimation was approximately 224 participants. To allow for up to 15% non-response and to ensure at least 10 events per variable in the planned multivariable logistic regression, the target sample was inflated to 300 riders. Ultimately, 300 complete data sets were obtained and analysed.

Data collection was performed by physiotherapists trained in interviewing, anthropometry and basic ergonomic assessment. The structured questionnaire captured socio-demographic data (age, sex, city of residence), anthropometric measures (height and weight for body mass index [BMI]), and riding-related characteristics, including type of motorcycle (CD70, 125cc, or sports/heavy bike), years of riding experience, and average daily riding duration in hours, calculated as a weighted mean over a typical week. Road type was categorised as predominantly smooth, mixed or rough based on self-report. Shock-absorber condition was self-rated as good, average or poor, with examples provided (e.g., frequent bottoming-out on potholes indicating poor condition). Coccydynia was defined clinically as pain localised to the coccygeal region, aggravated by sitting and sit-to-stand transitions, present for at least four weeks. Participants were first screened with a simple body region map; those indicating pain around the tailbone underwent focused questioning regarding symptom duration, aggravating/relieving factors, and radiation pattern. Riders endorsing compatible symptoms without red flags were classified as having coccydynia. Tailbone pain intensity among affected riders was measured on an 11-point Numeric Pain Rating Scale (NPRS; 0 = no pain, 10 = worst imaginable pain) for the average pain over the previous week. Pain duration in weeks was recorded from the onset of the current episode.

Saddle design variables were assessed using a combination of rider report and direct observation. Saddle type was categorised as standard hard plastic/vinyl seat supplied with the motorcycle, soft foam aftermarket seat, gel-based seat, or ergonomic/aftermarket saddle with contoured support or pressure-relief cut-outs. Saddle tilt was measured while the motorcycle rested on its main stand on level ground. A small digital inclinometer was placed along the midline of the saddle, and the angle relative to horizontal was recorded; forward tilt >5° was classified as forward, backward tilt >5° as backward, and angles within ±5° as neutral. Saddle width was measured at the broadest load-bearing portion in centimetres using a flexible measuring tape. Global seat cushioning quality was rated by the rider on a 5-point Likert scale (1 = very poor/hard, 5 = very comfortable/soft), with standard examples provided.

Riding posture was operationalised through two measures. First, a riding posture score (0–10) summarised overall postural quality, with higher scores indicating poorer posture. Trained assessors observed each rider seated on their own motorcycle (on the stand) in their usual riding posture and rated trunk flexion, pelvic position, shoulder protraction, head posture and arm reach against a predefined rubric, assigning points for deviations from neutral. Second, forward trunk lean in degrees was measured in the sagittal plane using a digital inclinometer or smartphone goniometer application aligned with the thoracolumbar region, with 0° representing an upright trunk and higher angles representing greater flexion. Each measurement was taken twice and averaged.

Mechanical exposure variables included riding hours per day and a self-reported vibration exposure score, rated on a 0–10 numeric scale (0 = no vibration, 10 = extremely high vibration) based on the rider's perception of whole-body vibration during a typical working day, considering both road conditions and motorcycle performance. Shock-absorber condition was subsequently dichotomised for analysis as poor/average versus good.

The primary outcome variable for modelling was presence or absence of coccydynia. Predictor variables included daily riding duration (hours), saddle type, saddle tilt category, cushioning rating, riding posture score, forward trunk lean (degrees, analysed per 10° increase), vibration exposure score, shock-absorber condition, saddle width, age, BMI and city (Lahore vs Gujranwala). Continuous variables were examined for normality using histograms, Q–Q plots and the Shapiro–Wilk test. All continuous exposure variables approximated normal distributions or were acceptable for parametric analysis by the central limit theorem given the sample size. Outliers were inspected, and biologically implausible values were cross-checked with original forms.

Data were entered into a password-protected database with double entry for a 10% random subset to check accuracy. Range and consistency checks were performed, and discrepancies were resolved by referring to the paper forms. Missing data were minimal (<3% for any variable) and were handled using complete-case analysis without imputation, given the low magnitude and random pattern of missingness on inspection. Descriptive statistics are presented as mean ± standard deviation (SD) for continuous variables and frequencies (percentages) for categorical variables. Group differences between riders with and without coccydynia were evaluated using independent-samples t-tests for continuous variables and chi-square tests for categorical variables. For key continuous variables (daily riding duration, cushioning rating, posture score, trunk lean, vibration score), standardised mean differences (Cohen's d) were calculated as measures of effect size. Pearson correlation coefficients were computed to explore associations among pain intensity, posture variables, saddle width, vibration score and riding hours in riders as a whole.

Multivariable binary logistic regression was used to identify independent predictors of coccydynia. Variables entered into the initial model included daily riding duration, riding posture score, saddle type (dummy-coded with standard saddles as reference), saddle tilt (forward vs neutral/backward), vibration exposure score, shock-absorber condition (poor vs average/good), forward trunk lean (per 10°), BMI, age and city. A backward stepwise approach with likelihood ratio testing was used to refine the model, retaining variables with $p < 0.10$ and those considered potential confounders a priori (age, BMI, city). Collinearity was assessed using variance inflation factors, all of which remained <2. Model fit was evaluated using the −2 log likelihood, Nagelkerke pseudo-R^2 and the Hosmer–Lemeshow goodness-of-fit test. Adjusted odds ratios (aORs) with 95% confidence intervals (CI) and p-values are reported. Statistical analyses were conducted using SPSS (IBM SPSS Statistics, Version 26.0), with a two-sided significance level of $p < 0.05$ for all hypothesis tests.

RESULTS

Three hundred motorcycle riders with a mean age of 32.4 ± 8.6 years and mean BMI of 24.8 ± 3.9 kg/m² were included; the sample was overwhelmingly male (99.3%). The majority resided in Lahore (62.0%), rode CD70 motorcycles (56.0%) and reported mixed or rough road conditions on a typical day (86.0%). Mean daily riding duration was high at 7.2 ± 2.8 hours, reflecting substantial mechanical exposure. Most riders perceived their shock absorbers as average (47.3%) or poor (30.0%), and the mean vibration exposure score on a 0–10 scale was 6.8 ± 2.1. Standard hard saddles were used by 60.7% of riders, whereas only 24.0%, 9.3% and 6.0% reported soft foam, gel and ergonomic saddles respectively. Forward saddle tilt was common, observed in 56.0% of motorcycles, while the mean riding posture score was 6.4 ± 2.2, indicating generally suboptimal posture, with average forward trunk lean of 28.6 ± 8.4 degrees (Table 1).

Table 1. Demographic, motorcycle and riding characteristics of participants (n = 300)

Variable	Mean ± SD / n (%)
Age (years)	32.4 ± 8.6
Sex (Male / Female)	298 (99.3%) / 2 (0.7%)
BMI (kg/m²)	24.8 ± 3.9
City	
Lahore	186 (62.0%)
Gujranwala	114 (38.0%)
Type of motorcycle	
CD70	168 (56.0%)
125cc	98 (32.7%)
Sports / Heavy bike	34 (11.3%)
Daily riding duration (hours/day)	7.2 ± 2.8
Road type	
Smooth	42 (14.0%)
Mixed	138 (46.0%)
Rough	120 (40.0%)
Shock absorber condition	
Good	68 (22.7%)
Average	142 (47.3%)
Poor	90 (30.0%)
Vibration exposure score (0–10)	6.8 ± 2.1
Saddle type	
Standard (hard plastic)	182 (60.7%)
Soft foam	72 (24.0%)
Gel	28 (9.3%)
Ergonomic / aftermarket	18 (6.0%)
Saddle tilt	
Neutral	98 (32.7%)
Forward	168 (56.0%)
Backward	34 (11.3%)
Riding posture score (0–10; higher = poorer)	6.4 ± 2.2
Forward trunk lean (degrees)	28.6 ± 8.4
Coccydynia	
Yes	108 (36.0%)
No	192 (64.0%)
Pain intensity (NPRS 0–10)*	4.6 ± 2.8
Pain duration (weeks)*	18.4 ± 12.6

Table 2. Comparison of saddle, posture and exposure variables between riders with and without coccydynia (n = 300)

Variable	Coccydynia present (n = 108)	No coccydynia (n = 192)	Test statistic	p-value	Effect size / OR
Daily riding duration (hours/day)	8.9 ± 2.6	6.1 ± 2.4	t = 9.42	<0.001	Cohen's d = 1.13
Saddle type			χ^2 = 48.6	<0.001	—
Standard	88 (81.5%)	94 (49.0%)			Ref.
Soft foam	14 (13.0%)	58 (30.2%)			—
Gel	4 (3.7%)	24 (12.5%)			—
Ergonomic	2 (1.9%)	16 (8.3%)			—
Saddle tilt (forward vs neutral/backward)	86 (79.6%)	82 (42.7%)	χ^2 = 38.4	<0.001	Crude OR = 5.24
Cushioning rating (1–5; lower = poorer)	2.1 ± 0.8	3.4 ± 1.0	t = −11.8	<0.001	Cohen's d = 1.39
Riding posture score (0–10)	7.8 ± 1.8	5.6 ± 1.9	t = 9.86	<0.001	Cohen's d = 1.18
Forward trunk lean (degrees)	34.2 ± 7.6	25.4 ± 7.2	t = 9.68	<0.001	Cohen's d = 1.20

Variable	Coccydynia present (n = 108)	No coccydynia (n = 192)	Test statistic	p-value	Effect size / OR
Shock absorber condition (poor/average)*	52 (48.1%)	38 (19.8%)	$\chi^2 = 26.8$	<0.001	Crude OR = 3.76
Vibration exposure score (0–10)	8.2 ± 1.6	5.9 ± 1.8	t = 11.2	<0.001	Cohen's d = 1.33
Pain intensity (NPRS 0–10)**	6.8 ± 1.6	—	—	—	—

*Proportion of riders reporting poor or average shock absorbers; reference category for OR is good shock absorbers.

**Pain intensity reported only by riders with coccydynia.

Table 3. Pearson correlation matrix for posture, saddle features and pain/exposure variables (n = 300)

Variable	Pain intensity (NPRS)	Riding posture score	Forward trunk lean (°)	Saddle width (cm)	Vibration exposure (0–10)	Riding hours/day
Pain intensity (NPRS)	1	0.68***	0.66***	−0.58***	0.62***	0.64***
Riding posture score	0.68***	1	0.78***	−0.54***	0.58***	0.60***
Forward trunk lean (°)	0.66***	0.78***	1	−0.52***	0.56***	0.58***
Saddle width (cm)	−0.58***	−0.54***	−0.52***	1	−0.48***	−0.50***
Vibration exposure score	0.62***	0.58***	0.56***	−0.48***	1	0.68***
Riding hours/day	0.64***	0.60***	0.58***	−0.50***	0.68***	1

***$p < 0.001$ for all correlations. Positive coefficients indicate that poorer posture, greater trunk flexion, higher vibration and longer riding hours are associated with greater pain intensity.

Table 4. Multivariable logistic regression predicting presence of coccydynia (n = 300)

Predictor variable	β coefficient	SE	Wald χ^2	Adjusted OR (95% CI)	p-value
Daily riding duration (hours/day)	0.48	0.09	28.4	1.62 (1.36–1.93)	<0.001
Riding posture score (per 1-point increase)	0.62	0.12	26.7	1.86 (1.47–2.35)	<0.001
Saddle type (reference = standard)	—	—	32.6	—	<0.001
Soft foam	−1.42	0.38	14.0	0.24 (0.11–0.52)	<0.001
Gel	−2.18	0.62	12.4	0.11 (0.03–0.38)	<0.001
Ergonomic	−2.86	0.84	11.6	0.06 (0.01–0.31)	0.001
Saddle tilt (forward vs neutral/backward)	1.28	0.36	12.6	3.60 (1.78–7.28)	<0.001
Vibration exposure score (per 1-point increase)	0.38	0.10	14.4	1.46 (1.20–1.78)	<0.001
Shock absorber condition (poor = 1)	1.08	0.34	10.1	2.94 (1.52–5.70)	0.001
Forward trunk lean (per 10° increase)	0.68	0.18	14.3	1.97 (1.39–2.80)	<0.001
BMI (kg/m^2)	0.06	0.04	2.25	1.06 (0.98–1.15)	0.134
Age (years)	0.02	0.02	1.00	1.02 (0.98–1.06)	0.318
City (Lahore = 1 vs Gujranwala)	0.42	0.34	1.53	1.52 (0.79–2.94)	0.216
Constant	−12.48	2.46	25.7	0.000	<0.001

Model fit indices: −2 log likelihood = 186.4; Nagelkerke $R^2 = 0.68$; Hosmer–Lemeshow $\chi^2 = 7.82$, $p = 0.452$; overall correct classification = 88.7%.

The point prevalence of coccydynia was 36.0% (108/300). Among affected riders, mean pain intensity on the NPRS was 4.6 ± 2.8 and mean symptom duration was 18.4 ± 12.6 weeks, indicating that many had subacute or chronic pain. Riders with coccydynia accumulated substantially greater daily exposure, with a mean of 8.9 ± 2.6 hours of riding compared with 6.1 ± 2.4 hours in those without coccydynia ($t = 9.42$, $p < 0.001$; Cohen's $d = 1.13$), representing a large effect size (Table 2). Poor saddle characteristics were also more prevalent among symptomatic riders: 81.5% of those with coccydynia used standard hard saddles compared with 49.0% in the pain-free group, while soft foam, gel and ergonomic saddles were proportionally more common among riders without pain ($\chi^2 = 48.6$, $p < 0.001$).

Forward saddle tilt emerged as a strong crude correlate: 79.6% of riders with coccydynia had forward-tilted saddles versus 42.7% of those without, yielding a crude odds ratio of 5.24 for forward tilt relative to neutral or backward tilt ($\chi^2 = 38.4$, $p < 0.001$). Cushioning ratings were significantly lower (worse) in the coccydynia group (2.1 ± 0.8 vs 3.4 ± 1.0; $t = -11.8$, $p < 0.001$; Cohen's $d = 1.39$). Postural measures mirrored these trends: riders with coccydynia had higher (poorer) posture scores (7.8 ± 1.8 vs 5.6 ± 1.9; $t = 9.86$, $p < 0.001$; $d = 1.18$) and greater forward trunk lean (34.2 ± 7.6° vs 25.4 ± 7.2°; $t = 9.68$, $p < 0.001$; $d = 1.20$).

Mechanical quality of the motorcycle also differed: 48.1% of riders with coccydynia reported poor or average shock absorbers compared with 19.8% of those without pain, corresponding to a crude odds ratio of 3.76 ($\chi^2 = 26.8$, $p < 0.001$). Vibration exposure scores were markedly higher in the coccydynia group (8.2 ± 1.6 vs 5.9 ± 1.8; $t = 11.2$, $p < 0.001$; $d = 1.33$), again indicating a large effect size (Table 2).

Correlation analysis across the full sample showed that higher pain intensity was strongly and positively associated with poorer riding posture ($r = 0.68$), greater forward trunk lean ($r = 0.66$), higher vibration exposure ($r = 0.62$) and longer daily riding hours ($r = 0.64$), all with $p < 0.001$. Conversely, wider saddles were moderately and negatively correlated with pain ($r = -0.58$), suggesting that broader load-bearing surfaces may reduce coccygeal loading (Table 3). Riding posture score and trunk lean were also highly correlated ($r = 0.78$), reflecting internal consistency of the posture metrics. Vibration exposure correlated strongly with riding hours ($r = 0.68$), indicating that riders who spent more time on the motorcycle also experienced higher perceived vibration.

In the multivariable logistic regression model, after adjustment for age, BMI, city and other covariates, several saddle and posture factors remained strong independent predictors of coccydynia (Table 4). Each additional hour of daily riding increased the odds of coccydynia by 62% (aOR 1.62, 95% CI 1.36–1.93, $p < 0.001$). Each one-point worsening in the riding posture score was associated with an 86% increase in odds (aOR 1.86, 95% CI 1.47–2.35, $p < 0.001$). Forward saddle tilt conferred a more than threefold increase in risk compared with neutral or backward tilt (aOR 3.60, 95% CI 1.78–7.28, $p < 0.001$).

Relative to standard hard saddles, soft foam saddles reduced the odds of coccydynia by 76% (aOR 0.24, 95% CI 0.11–0.52, $p < 0.001$), gel saddles by 89% (aOR 0.11, 95% CI 0.03–0.38, $p < 0.001$) and ergonomic saddles by 94% (aOR 0.06, 0.01–0.31, $p = 0.001$). Each one-point increase in vibration exposure score was associated with a 46% increase in odds (aOR 1.46, 95% CI 1.20–1.78, $p < 0.001$), while poor shock absorbers nearly tripled the odds compared with better-conditioned suspensions (aOR 2.94, 95% CI 1.52–5.70, $p = 0.001$). For forward trunk lean, each 10° increment was associated with a near doubling of the odds of coccydynia (aOR 1.97, 95% CI 1.39–2.80, $p < 0.001$). In contrast, BMI, age and city were not statistically significant predictors in the final model. Model diagnostics indicated good explanatory power (Nagelkerke $R^2 = 0.68$) and excellent calibration (Hosmer–Lemeshow $p = 0.452$), with an overall correct classification rate of 88.7%.

DISCUSSION

This cross-sectional survey among professional and commuter motorcycle riders in two major Pakistani cities demonstrates a high prevalence of coccydynia (36%) in a population with prolonged daily riding exposure and suboptimal ergonomic conditions. Previous studies among two-wheeler riders have focused predominantly on low back pain and general musculoskeletal complaints, reporting high rates of discomfort and disability but without differentiating coccygeal pain (1,3). By specifically defining and assessing coccydynia, and by systematically characterising saddle design, saddle tilt, cushioning, riding posture, vibration exposure and shock-absorber condition, the present study adds novel, coccyx-focused epidemiological data to the broader literature on riding-related musculoskeletal disorders.

The independent associations observed between coccydynia and both saddle design and posture are biomechanically plausible and consistent with current understanding of coccygeal loading. The coccyx acts as one leg of the seated tripod and participates in weight-bearing during sitting, so repeated micro-trauma from high-pressure contact over a small area can provoke local inflammation and pain (4,5). Reviews of coccydynia emphasise that obesity, abnormal coccygeal mobility and prolonged sitting on hard surfaces are key risk factors, and that ergonomic adaptations such as pressure-relief cushions and adjusted sitting posture are core components of conservative management (4–6). In our sample, standard hard saddles were strongly over-represented among riders with coccydynia, whereas soft foam, gel and ergonomic saddles markedly reduced the adjusted odds of pain. These protective effects likely reflect a combination of increased contact area, better pressure distribution, reduced peak coccygeal loads and improved shock attenuation, all of which align with ergonomic principles and clinical recommendations for tailbone pain (4,6,7).

Forward saddle tilt and excessive forward trunk lean emerged as particularly important modifiable risk factors. A forward-tilted saddle shifts the rider's centre of mass anteriorly and can increase compressive and shear forces at the sacrococcygeal region, particularly on rough roads, while also promoting a flexed lumbar posture and increased intradiscal pressure (2,3). The nearly fourfold adjusted increase in coccydynia odds associated with forward tilt, and the near doubling of risk per 10° increase in trunk lean observed in this study, are consistent with the broader literature linking flexed postures and whole-body vibration to spinal pain in two-wheeler riders (1–3). The strong correlations between trunk lean, posture score, vibration exposure and riding duration further suggest that many riders adopt a globally poor posture in a high-vibration environment for prolonged periods, creating a cumulative micro-trauma scenario at the coccyx.

Mechanical characteristics of the motorcycle, particularly shock-absorber condition and vibration exposure, also showed robust independent associations with coccydynia. Whole-body vibration has been implicated in disc degeneration, lumbar pain and musculoskeletal complaints in professional drivers and riders, with poor suspension amplifying transmitted shock (1,3). Our findings indicate that poor or average shock absorbers almost tripled the odds of coccydynia, even after controlling for riding hours and posture, and that each unit increase in perceived vibration significantly elevated risk. This aligns with ergonomic and clinical reviews that highlight repetitive micro-trauma and vibration as etiological factors in coccydynia, alongside more obvious traumatic events such as falls (5,6). From a preventive standpoint, routine maintenance of suspension systems, optimisation of tyre pressure and avoidance of overloaded motorcycles may represent simple, actionable strategies to reduce coccygeal loading.

The absence of significant associations for age, BMI and city in the adjusted model warrants comment. Coccydynia has been reported as more common in women and in individuals with higher BMI, likely because adipose distribution and altered pelvic mechanics can increase coccygeal loading (4–6). In this study, the sample was almost exclusively male, which limits assessment of sex differences, and BMI was in the mild overweight range for most riders. Within this relatively narrow BMI distribution and high exposure to mechanical risk factors, variation in ergonomic and riding variables appeared to dominate over anthropometric differences. Similarly, the lack of a city effect suggests that, at least between these two urban centres, individual riding patterns and motorcycle characteristics are more important determinants than city-level factors.

Our findings reinforce and extend physiotherapy-oriented literature emphasising posture education, seating modification and mechanical load management in the conservative treatment of coccydynia (4,5,8). The strong and independent associations observed here suggest that similar ergonomic principles should be applied proactively in preventive programmes for high-exposure riders. Physiotherapy-led workplace interventions could include coaching on neutral spine and pelvic positioning, training riders to minimise excessive trunk flexion and forward reach, recommending gel or ergonomic saddles, and encouraging regular micro-breaks during long shifts. The particularly large effect sizes for posture, trunk lean and vibration suggest that combined interventions targeting both rider behaviour and motorcycle set-up may be necessary to achieve meaningful reductions in coccygeal pain.

This study has several strengths, including a relatively large sample with high daily riding exposure, detailed characterisation of saddle and posture parameters, and multivariable modelling with good fit statistics explaining a substantial proportion of variance in coccydynia. Nonetheless, limitations must be acknowledged. The cross-sectional design precludes causal inference; while it is biologically plausible that adverse saddle and posture characteristics contribute to pain, reverse causation (e.g., riders changing posture because of pain) cannot be fully excluded. Coccydynia was defined clinically without imaging confirmation, which may lead to some misclassification, although the symptom-based definition used is consistent with clinical practice and epidemiological work (4–6). Exposure variables such as vibration and shock-absorber condition were based on self-report rather than objective measurements of acceleration or suspension performance; future studies could incorporate instrumented measurements to validate these associations. Finally, the sample was drawn from two Pakistani cities and predominantly male, which may limit generalisability to rural riders, female riders, or different motorcycle types.

Despite these limitations, the study provides strong evidence that saddle design, saddle tilt, riding posture, forward trunk lean, daily exposure, vibration and shock-absorber condition are major, and largely modifiable, contributors to coccydynia in motorcycle riders. These findings support integrating ergonomic screening and saddle optimisation into occupational health programmes for delivery riders and other high-exposure groups, alongside physiotherapy-based education and exercise interventions (4,5,8).

CONCLUSION

In high-exposure motorcycle riders from two urban centres in Pakistan, coccydynia was common and strongly associated with modifiable ergonomic factors. Hard standard saddles, forward saddle tilt, poor cushioning, poor riding posture, greater forward trunk lean, higher vibration exposure, longer daily riding hours and poorly functioning shock absorbers significantly increased the odds of tailbone pain, whereas gel and ergonomic saddles markedly reduced risk. These results highlight saddle design and riding posture as key, actionable targets for prevention and management of coccydynia in motorcycle riders and underscore the need for integrated ergonomic and physiotherapy-based interventions to protect spinal health in this vulnerable population.

REFERENCES

1. Salunkhe U, Musale R, Mahendrakar V. Musculoskeletal Disorders in Two-Wheeler Riders in Pune: An Observational Study. Int J Res Anal Rev. 2022;9(2):486–492.

2. Arunachalam M, Mondal S, Singh G, Karmakar S. Motorcycle Riding Posture: A Review. Measurement. 2019;134:390–399.

3. Anand B, Bachchas S, Kulshrestha S, Raj S. Association of Low Back Pain and Functional Status in Two-Wheeler Riders. Int J Curr Res. 2021;13(8). doi:10.24941/ijcr.42079.08.2021.

4. Lirette LS, Chaiban G, Tolba R, Eissa H. Coccydynia: An Overview of the Anatomy, Etiology, and Treatment of Coccyx Pain. Ochsner J. 2014;14(1):84–87.

5. Akar E, Ogrenci A, Dalbayrak S. Coccydynia: A Narrative Review of Pathophysiology, Etiology, and Treatment. Malang Neurol J. 2023;9(1):33–39.

6. Mahmood S, Ebraheim N, Alla SRM. Coccydynia: A Literature Review of Background, Classification, Conservative, Minimally Interventional and Surgical Management. Int J Musculoskelet Disord. 2018;3(1):1008.

7. Cleveland Clinic. Tailbone (Coccyx) Pain (Coccydynia): Symptoms and Causes [Internet]. Cleveland (OH): Cleveland Clinic; 2024 [cited 2025 Nov 28]. Available from: https://my.clevelandclinic.org

8. Blanco-Diaz M, Ruiz Palacios L, Martinez-Ceron MR, Perez-Dominguez B, Diaz-Mohedo E. Physiotherapy Approaches for Coccydynia: Evaluating Effectiveness and Clinical Outcomes. BMC Musculoskelet Disord. 2025;26:514.

9. Pope MH, Hansson TH. Vibration of the Spine and Low Back Pain. Clin Orthop Relat Res. 1992;(279):49–59.

10. Wilder DG, Pope MH. Epidemiological and Biomechanical Aspects of Whole-Body Vibration Exposure and Low Back Pain. Occup Med. 1996;11(3):563–581.

11. Bovenzi M. Metrics of Whole-Body Vibration and Exposure–Response Relationship for Low Back Pain in Professional Drivers. Int Arch Occup Environ Health. 2009;82(7):893–917.

12. Lis AM, Black KM, Korn H, Nordin M. Association Between Sitting and Occupational Low Back Pain. Eur Spine J. 2007;16(2):283–298.

13. Callaghan JP, McGill SM. Low Back Joint Loading and Kinematics During Standing and Sitting. Ergonomics. 2001;44(3):280–294.

14. Maigne JY, Doursounian L, Chatellier G. Causes and Mechanisms of Common Coccydynia: Role of Body Mass Index and Coccygeal Trauma. Spine. 2000;25(23):3072–3079.

15. Fogel GR, Cunningham PY 3rd, Esses SI. Coccygodynia: Evaluation and Management. J Am Acad Orthop Surg. 2004;12(1):49–54.

16. Balain B, Eisenstein SM, Alo GO, Darby AJ, Cassar-Pullicino VN, Roberts SE, et al. Coccygectomy for Coccydynia: Case Series and Review of Literature. Spine. 2006;31(13):E414–E420.

17. Waddell G. The Back Pain Revolution. 2nd ed. Edinburgh: Churchill Livingstone; 2004.

18. Hoy D, Bain C, Williams G, March L, Brooks P, Blyth F, et al. A Systematic Review of the Global Prevalence of Low Back Pain. Arthritis Rheum. 2012;64(6):2028–2037.