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Comparative Analysis of Low-Back Pain and Concurrent Neck Pain-Associated Disability Among Sports Bikers and Non-Sports Bikers: An Observational Cross-Sectional Study with Health-Related Quality-of-Life Correlates.

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Abstract : Motorcycle riding imposes unique biomechanical and postural demands that predispose riders to musculoskeletal pain and functional impairment, particularly involving the lumbar and cervical spine. This study aimed to comprehensively evaluate pain intensity, region-specific disability, and health-related quality of life (HRQoL) among sports and non-sports bikers, while examining gender-specific variations and interrelationships among pain, disability, and HRQoL domains. A cross-sectional analytical design was employed, involving adult motorcyclists stratified by riding type and gender. Standardized instruments including the Visual Analogue Scale (VAS), Modified Oswestry Low Back Pain Disability Questionnaire (MOLBPDQ), Neck Disability Index (NDI), and SF-20 HRQoL questionnaire were utilized. Descriptive statistics, inferential comparisons, effect size estimation, and correlation analyses were performed to elucidate both magnitude and directionality of associations. The findings revealed a substantial burden of low-back and neck pain across the cohort, with sports bikers demonstrating significantly higher pain intensity and lumbar disability compared to non-sports bikers. Gender-based analyses showed nuanced differences, particularly in age distribution and selected HRQoL domains, though pain perception remained broadly comparable. Correlational analyses demonstrated meaningful associations between pain intensity and disability indices, as well as selective HRQoL domains, highlighting the multidimensional consequences of musculoskeletal strain. Marginal difference analysis further underscored clinically relevant contrasts between riding types, particularly in pain, disability, and health perception domains. These findings emphasize the complex interplay between biomechanical exposure, pain, functional limitation, and perceived health status in motorcyclists. The study provides a robust empirical foundation for targeted ergonomic interventions, preventive strategies, and individualized rehabilitation protocols tailored to rider type and demographic characteristics.

IndexTerms - Musculoskeletal Pain, Motorcyclists, Functional Disability, Health-Related Quality of Life, Biomechanical Load.

I. INTRODUCTION

Motorcycle riding, while widely embraced for transportation, recreation, and professional purposes, constitutes a physically demanding activity characterized by sustained postures, repetitive mechanical loading, and exposure to whole-body vibration. These factors collectively impose considerable stress on the musculoskeletal system, particularly the lumbar and cervical regions of the spine[(1–5)]. The increasing global prevalence of motorcycling has been paralleled by a growing recognition of riding-related musculoskeletal disorders, which frequently manifest as chronic pain, functional disability, and diminished quality of life[(6–9)]. Sports motorcyclists, in particular, adopt aggressive forward-flexed postures that intensify spinal compression, muscular fatigue, and joint loading. Conversely, non-sports bikers, although generally exposed to less extreme postural demands, may experience cumulative strain due to prolonged riding durations and suboptimal ergonomics. Despite these distinctions, empirical evidence directly comparing musculoskeletal outcomes between sports and non-sports bikers remains limited and fragmented. Furthermore, gender-specific variations in pain perception, disability reporting, and health-related quality of life have not been adequately explored within this population[10].

Low-back pain and neck pain represent leading contributors to functional limitation among riders, often interfering with occupational performance, recreational activities, and psychosocial well-being. Disability indices such as the MOLBPDQ and NDI provide quantifiable insight into region-specific functional impairment, while HRQoL instruments capture broader dimensions of health encompassing physical, mental, and social domains. Integrating these outcome measures allows for a holistic assessment of rider health beyond isolated symptom reporting. Understanding the interrelationships among pain intensity, disability, and HRQoL is critical for informing evidence-based preventive and rehabilitative strategies. Moreover, evaluating marginal differences across gender and riding type facilitates identification of vulnerable subgroups and supports the development of personalized interventions. Therefore, this study was designed to systematically analyse musculoskeletal pain, disability, and HRQoL among sports and non-sports bikers, with particular emphasis on gender-based differences, correlation patterns, and clinical relevance of observed marginal variations[11–16].

II. Methodology

The present investigation was designed as an observational, comparative, cross-sectional epidemiological study aimed at elucidating the relationship between motorcycle riding posture and musculoskeletal health outcomes, particularly low-back pain, concomitant neck pain, functional disability indices, and health-related quality of life (HRQoL). The cross-sectional framework was methodologically appropriate for estimating the prevalence of musculoskeletal symptoms, delineating co-occurrence patterns of spinal pain, quantifying functional disability burden, and comparing risk distribution between distinct motorcyclist subpopulations. By assessing exposure (type of motorcycle riding posture) and outcomes concurrently, the study preserved ecological validity while allowing robust associational inferences without experimental manipulation. Data collection was conducted in real-world riding environments to ensure representativeness of habitual exposure. Recruitment sites included urban and semi-urban commuting corridors, motorcycling congregation zones, organized riding clubs, university campuses, transportation hubs, and major arterial highways. Wherever feasible, structured screening and questionnaire administration were also conducted in controlled environments such as academic institutions, physiotherapy outpatient departments, and community workplaces to enhance privacy, minimize response bias, and uphold ethical standards.

The study population comprised adult motorcycle riders aged 18–55 years with a minimum of one year of riding experience. A total sample of 318 participants was included, stratified into two analytically distinct cohorts based on motorcycle type and riding posture: Non-Sports Bikers (n = 156; 49.05%) and Sports Bikers (n = 162; 50.94%). This near-equitable distribution facilitated balanced comparative analyses. Within the Sports Bikers group, the majority were males (156; 96.29%), while females constituted a small proportion (5; 3.08%). Similarly, in the Non-Sports Bikers group, males predominated (148; 94.87%), with females comprising 8 participants (5.12%). Collectively, the combined sample consisted of 305 males (95.91%) and 13 females (4.08%), reflecting the male-dominant demographic of motorcycle riders in the studied context. A consecutive sampling approach was implemented, whereby eligible participants encountered during field recruitment were systematically screened and enrolled until the required sample size was achieved. Sample size estimation was informed by anticipated prevalence differentials from prior musculoskeletal epidemiology studies, consideration of minimum detectable effect, an alpha level of 0.05, and a statistical power of 0.80, ensuring adequate sensitivity to detect meaningful intergroup differences.

Eligibility criteria were stringently defined to enhance internal validity. Inclusion criteria encompassed riders aged 18–55 years, with at least one year of riding experience, riding a minimum of three days per week, providing voluntary informed consent, and meeting operational definitions of sports or non-sports biking. Exclusion criteria eliminated individuals with a history of major spinal trauma, fractures, or surgery; diagnosed neurological, rheumatological, or systemic musculoskeletal disorders; congenital spinal deformities or scoliosis; acute infectious or inflammatory spinal pathology; pregnancy, vestibular disorders, or recent accidents; and professional competitive riders, to minimize extreme exposure bias. The primary independent variable was type of motorcycle riding (Sports vs. Non-Sports). Demographic and anthropometric variables included age, gender, height, weight, and body mass index (BMI). Riding-related exposure variables encompassed daily riding duration, years of riding experience, average weekly riding hours, and travel purpose (commuting, recreational, or occupational). Clinical outcome variables included presence and severity of low-back pain, associated neck pain, Modified Oswestry Low-Back Pain Disability Questionnaire (MOLBPDQ %) scores, Neck Disability Index (NDI %) scores, and HRQoL domains, namely Physical Functioning (PF), Role Functioning (RF), Social Functioning (SF), Mental Health (MH), Health Perception (HP), and Pain (P). All outcome measures were standardized on 0–100 scales to facilitate uniform interpretation.

Validated assessment tools were utilized, including a structured demographic and exposure questionnaire, MOLBPDQ, NDI, and SF-20 HRQoL domains. These instruments are well-established in musculoskeletal research, with high internal consistency ($\alpha > 0.85$ for MOLBPDQ) and strong test-retest reliability (ICC > 0.90 for NDI), thereby enhancing methodological rigor and reproducibility. Data collection followed a standardized protocol: eligible participants were informed about study objectives, written informed consent was obtained, anthropometric data were recorded or verified, and questionnaires were completed under investigator supervision. Clarifications were provided neutrally without influencing responses. All completed forms were reviewed for completeness, and missing or inconsistent entries were addressed where possible. Data were anonymized using coded identifiers to ensure confidentiality. Quality assurance measures included manual verification of data entries, identification and reassessment of outliers, double-entry validation, and systematic cross-checking. Only complete and validated datasets were included in the final analysis.
Methodological strengths of the study included the use of validated clinical and HRQoL instruments, clearly defined operational subgroup classifications, ecologically valid sampling in real-world riding environments, and simultaneous assessment of both lumbar and cervical pain rather than isolated spinal segments. However, limitations included the cross-sectional design, which precludes causal inference; reliance on self-reported riding exposure and symptom recall; and the absence of direct biomechanical load measurements. These constraints were acknowledged and mitigated through rigorous screening, standardized administration, and robust data validation procedures.

III. Results

The present analytical exploration yielded a comprehensive, multidimensional characterization of musculoskeletal health among motorcyclists, delineating a complex constellation of pain prevalence, quantifiable functional disability, and heterogeneous health-related quality of life (HRQoL) outcomes. Collectively, the findings illuminate the intricate biomechanical, physiological, and psychosocial interactions that underpin musculoskeletal dysfunction in this occupational and recreational cohort. Rather than representing isolated clinical phenomena, pain, disability, and HRQoL emerged as interdependent constructs, reciprocally reinforcing one another through both direct and indirect pathways. At the descriptive level, the study population was predominantly composed of young adults, reflecting the demographic profile commonly associated with active motorcycle use. This age distribution is of particular relevance, as it underscores the early onset of musculoskeletal strain within a population traditionally perceived as biomechanically resilient. The anthropometric parameters exhibited substantial variability, encompassing a wide spectrum of body compositions, from lean to overweight phenotypes. Such heterogeneity in body composition is clinically salient, given the established influence of anthropometric characteristics on spinal loading, postural stability, and muscular endurance. Importantly, the observed variability also enhances the external validity of the findings, ensuring that the analytical outcomes are not restricted to a narrowly defined morphological subgroup. Distributional analyses demonstrated acceptable skewness and kurtosis across the majority of variables, thereby satisfying the statistical assumptions required for parametric testing. The confirmation of approximate normality is not merely a procedural formality; rather, it reinforces the robustness and reliability of the inferential conclusions drawn from subsequent analyses. In populations characterized by subjective symptom reporting, deviations from normality often reflect response biases or clustering effects. The absence of such distortions in the present dataset suggests consistent reporting behavior and strengthens confidence in the observed associations.
Pain intensity emerged as a central feature of the musculoskeletal profile, with aggregate scores indicating a moderate overall burden across the cohort. However, this aggregate perspective obscures critical subgroup distinctions. Sports bikers consistently reported higher pain intensity compared to their non-sports counterparts, a difference that achieved statistical significance and was accompanied by a large effect size. The magnitude of this effect underscores the clinical relevance of riding typology as a determinant of musculoskeletal strain. From a biomechanical standpoint, sports motorcycles necessitate a pronounced forward-flexed posture, increased cervical extension, and sustained isometric contraction of paraspinal and scapular stabilizing musculature. These postural demands amplify axial loading, elevate intradiscal pressure, and accelerate muscular fatigue, thereby predisposing riders to heightened pain perception. The alignment between statistical significance and large effect size is particularly noteworthy, as it signifies that the observed differences are not merely artifacts of sample size but represent substantive, clinically meaningful disparities. This finding reinforces the imperative to differentiate between sports and non-sports riding modalities in both epidemiological surveillance and clinical assessment, rather than treating motorcyclists as a homogenous group.
Low-back disability, as quantified by the Modified Oswestry Low Back Pain Disability Questionnaire (MOLBPDQ), mirrored the pattern observed for pain intensity. Sports bikers exhibited significantly higher disability scores, indicating greater functional impairment in activities of daily living. This congruence

between pain severity and lumbar disability is biomechanically intuitive, given the lumbar spine's role as a primary load-bearing structure during motorcycle riding. Prolonged trunk flexion, combined with vibration exposure and intermittent high-impact forces during acceleration and braking, likely contributes to cumulative microtrauma of lumbar structures. Over time, these mechanical insults manifest as activity limitations, reflected in elevated MOLBPDQ scores. In contrast, neck disability scores, while elevated across both groups, demonstrated comparatively smaller intergroup differences. This nuanced finding suggests that cervical loading mechanisms may be less sensitive to riding typology than lumbar loading or may reach a saturation threshold beyond which additional biomechanical stress does not proportionally increase perceived disability. Alternatively, cervical discomfort may be more uniformly distributed across riding types due to universal requirements for sustained visual orientation, helmet weight bearing, and environmental scanning. The relative attenuation of intergroup differences in neck disability underscores the importance of region-specific analyses when evaluating spinal health, as different segments of the spine may respond divergently to similar exposure profiles.

Gender-based analyses revealed further layers of complexity. Females were generally younger than males across cohorts, a demographic distinction that may reflect sociocultural patterns of motorcycle adoption or differing thresholds for sustained riding engagement. Despite this age disparity, pain intensity did not differ significantly between genders, suggesting that nociceptive experience may be shaped more by exposure characteristics than by sex alone within this population. However, selected disability and HRQoL domains exhibited marginal gender-based variations, indicating that while pain perception may be comparable, its functional and psychosocial ramifications may diverge subtly between males and females. Notably, role functioning and health perception domains demonstrated trends suggestive of gender-specific experiential differences. These trends, although not uniformly statistically significant, warrant careful interpretation. Role functioning encapsulates the extent to which physical health interferes with occupational and social responsibilities, while health perception reflects subjective appraisal of overall well-being. The observed gender trends may be influenced by differential role expectations, coping strategies, and health appraisal frameworks. Females may interpret and report the impact of musculoskeletal symptoms through a psychosocial lens distinct from that of males, even when objective pain intensity is comparable. Such differences highlight the importance of integrating gender-sensitive frameworks into musculoskeletal research and rehabilitation planning.

Correlation analyses provided critical insight into the structural relationships among study variables, revealing coherent and theoretically grounded association patterns. Pain intensity demonstrated positive correlations with both lumbar and cervical disability indices, corroborating the intuitive and empirically supported linkage between symptom severity and functional limitation. This finding reinforces the construct validity of the measurement instruments and underscores pain as a primary driver of disability within the motorcyclist population. Beyond this direct relationship, disability indices exhibited selective associations with HRQoL domains, particularly role functioning and mental health. These associations illuminate the broader psychosocial sequelae of musculoskeletal impairment. Functional limitations imposed by pain may curtail occupational productivity, recreational engagement, and social participation, thereby exerting downstream effects on psychological well-being. The selective nature of these associations suggests that not all HRQoL domains are equally vulnerable to musculoskeletal dysfunction. Physical health perceptions and role functioning appear particularly sensitive, while other domains may be buffered by adaptive coping mechanisms or social support structures. The identification of mental health associations is especially salient, as it underscores the bidirectional interplay between physical dysfunction and psychological state. Chronic pain and disability may precipitate emotional distress, while pre-existing psychological vulnerability may amplify pain perception and disability reporting. This reciprocal relationship underscores the necessity of adopting a biopsychosocial framework when addressing musculoskeletal health in motorcyclists, rather than relying exclusively on biomechanical or structural paradigms.

Anthropometric variables emerged as significant modulators within the analytical framework. Body mass index (BMI) demonstrated strong positive associations with body weight and inverse associations with height, reflecting expected mathematical and biomechanical relationships. However, beyond these structural associations, BMI may exert a more nuanced influence on musculoskeletal outcomes. Elevated BMI increases axial loading on spinal structures, augments muscular demand for postural stabilization, and may exacerbate inflammatory pathways associated with pain perception. Conversely, lower height may influence leverage and centre-of-mass dynamics during riding, potentially altering load distribution across spinal segments. Age demonstrated modest but meaningful correlations with selected outcomes, suggesting cumulative exposure effects. Although the cohort was relatively young, even incremental increases in age may correspond to longer riding histories, greater cumulative vibration exposure, and progressive degenerative changes. The presence of age-related associations within a young adult population underscores the insidious nature of musculoskeletal strain in motorcyclists and challenges assumptions that significant impairment is confined to older riders.

Marginal difference analysis provided an additional layer of interpretive granularity by quantifying absolute and percentage differences across gender and riding type. This analytical approach is particularly valuable in clinical contexts, as it highlights differences that may not reach conventional thresholds of statistical significance yet possess practical relevance. The marginal differences observed between sports and non-sports bikers in pain, disability, and health perception domains were substantial enough to warrant clinical attention. Even modest percentage differences in pain or disability may translate into meaningful disparities in functional capacity, injury risk, and long-term health outcomes. Importantly, marginal differences also contextualize the lived experience of riders. For instance, a percentage increase in pain or disability may disproportionately affect individuals whose occupational or recreational activities demand high physical performance. Thus, marginal difference analysis bridges the gap between statistical abstraction and real-world clinical relevance. Collectively, the findings portray a multidimensional burden of musculoskeletal dysfunction among motorcyclists, characterized by the convergence of biomechanical strain, functional limitation, and compromised quality of life. Riding type emerged as a salient determinant of pain and disability, with sports bikers exhibiting a distinctly heightened risk profile. HRQoL outcomes reflected the downstream impact of physical strain, extending beyond somatic symptoms to encompass role limitations and psychological well-being.

From a broader scientific perspective, these findings challenge reductionist interpretations of musculoskeletal pain as a purely mechanical phenomenon. Instead, they advocate for an integrative understanding that recognizes the interplay between posture, load exposure, individual morphology, psychosocial context, and adaptive capacity. Such an understanding is essential for the development of effective preventive strategies, ergonomic interventions, and rehabilitation programs tailored to the unique demands of motorcyclists. In summary, the present analysis advances the field by providing a nuanced, empirically grounded depiction of musculoskeletal health among motorcyclists. By elucidating the differential impact of riding type, gender, and anthropometric factors on pain, disability, and HRQoL, the study lays a robust foundation for targeted clinical interventions and future longitudinal investigations. The multidimensional burden identified herein underscores the urgent need for proactive, evidence-based approaches to preserve spinal health and optimize quality of life within this growing population.

IV. Discussion

The present investigation provides a comprehensive and multidimensional appraisal of musculoskeletal health among motorcyclists, elucidating the intricate interrelationships between pain intensity, functional disability, and health-related quality of life (HRQoL)[17,18]. By stratifying participants according to biker type (sports versus non-sports) and gender, and by integrating descriptive, correlational, and marginal difference analyses, this study advances current understanding beyond mere prevalence estimates, offering mechanistic and clinically meaningful interpretations. Collectively, the findings substantiate the premise that musculoskeletal morbidity in motorcyclists is neither homogeneous nor incidental, but rather shaped by a constellation of biomechanical exposures, anthropometric moderators, and psychosocial determinants[1,3,4,7,19,20].

Pain Prevalence and Disability Burden

One of the most prominent observations in this study is the substantial burden of musculoskeletal pain across the cohort, with sports bikers consistently exhibiting higher pain intensity scores than non-sports bikers. This differential pain profile is clinically significant and aligns with established biomechanical principles governing spinal loading during motorcycle riding. Sports motorcycles impose a sustained forward-flexed trunk posture, increased cervical extension, and continuous upper-limb weight bearing, all of which contribute to abnormal load transmission across spinal segments. The prolonged maintenance of such postures is known to induce muscular fatigue, ligamentous creep, and altered neuromuscular control, thereby predisposing riders to chronic pain syndromes[12,14,16,21–23]. Low-back disability, as quantified using the Modified Oswestry Low Back Pain Disability Questionnaire (MOLBPDQ), mirrored the pain intensity findings, further reinforcing the link between biomechanical stress and functional impairment. The elevated MOLBPDQ scores among sports bikers suggest that lumbar spine structures bear disproportionate mechanical demands during high-performance riding. In contrast, neck disability, assessed via the Neck Disability Index (NDI), while prevalent across both groups, demonstrated comparatively smaller intergroup differences. This nuanced pattern may reflect differential adaptation strategies of the cervical musculature or variations in helmet weight distribution, riding duration, and visual scanning demands, which may attenuate stark contrasts between biker types [24–27].

Gender-Based Variations and Psychosocial Context

Gender-stratified analyses revealed subtle yet noteworthy patterns. Although pain intensity did not differ significantly between males and females, selected disability indices and HRQoL domains exhibited marginal variations. Females were generally younger across cohorts, a demographic feature that may partially modulate pain perception and reporting. Existing literature suggests that gender differences in pain experience are mediated not only by biological factors, such as hormonal influences and nociceptive processing, but also by psychosocial constructs including coping strategies, pain catastrophizing, and health-seeking behaviors. The marginally higher disability scores observed in certain domains among female participants may reflect heightened sensitivity to functional limitations or greater awareness of bodily discomfort. Conversely, males may underreport symptoms due to sociocultural norms emphasizing stoicism and endurance. Importantly, these gender-based trends did not uniformly reach statistical significance, underscoring the complexity of disentangling biological sex effects from contextual and behavioral influences. Nonetheless, the presence of consistent marginal differences suggests that gender remains a relevant modifier of musculoskeletal health outcomes and warrants consideration in both preventive and rehabilitative interventions[(28–32)].

Health-Related Quality of Life and Multidimensional Impact

HRQoL assessment using the SF-20 instrument revealed that musculoskeletal pain and disability exerted domain-specific effects rather than uniformly degrading perceived health status. Domains related to role functioning, physical health perception, and mental health were particularly sensitive to variations in pain and disability indices. This selective vulnerability underscores the multifaceted nature of HRQoL, wherein physical impairment does not necessarily translate into proportional decrements across all life domains. The association between pain intensity and HRQoL-physical and role functioning domains highlights the tangible impact of musculoskeletal symptoms on daily activities, occupational performance, and social participation. Meanwhile, the observed correlations between disability indices and mental health domains point to the psychological sequelae of chronic pain, including emotional distress, reduced self-efficacy, and diminished life satisfaction. These findings reinforce the biopsychosocial model of pain, which conceptualizes musculoskeletal disorders as emergent phenomena arising from the interplay of physical pathology, cognitive appraisal, and social context [(7,17–19,33,34)].

Correlation and Association Insights

The correlation analyses provide critical insight into the interdependence of pain, disability, and HRQoL outcomes. Pain intensity demonstrated significant positive associations with both MOLBPDQ and NDI scores, confirming the intuitive and empirically supported link between symptom severity and functional limitation. However, the strength of these correlations was moderate rather than strong, suggesting that factors beyond pain intensity alone contribute to disability perception. This observation is consistent with contemporary pain science, which recognizes that disability is modulated by fear-avoidance beliefs, movement confidence, and psychosocial resilience. Disability indices, in turn, exhibited selective associations with HRQoL domains. Notably, role functioning and mental health emerged as particularly sensitive to functional impairment, whereas social functioning and general health perception displayed more variable relationships. The presence of both Pearson and Spearman correlations of similar magnitude suggests that these associations are robust across linear and monotonic analytical frameworks, further strengthening their interpretative validity[(35,36).]

Anthropometry, Age, and Modulatory Effects

Anthropometric variables exerted a modulatory influence on musculoskeletal outcomes. Body mass index (BMI) demonstrated strong associations with weight and inverse associations with height, reflecting expected physiological relationships. More importantly, elevated BMI values were associated with increased pain and disability in certain analyses, implicating excess body mass as a contributor to spinal loading and mechanical strain. Increased axial loading may accelerate degenerative processes, compromise postural endurance, and amplify vibratory transmission during riding. Age exhibited modest but significant correlations with selected pain and HRQoL outcomes, suggesting cumulative exposure effects. Older riders may experience age-related declines in muscular strength, spinal flexibility, and tissue repair capacity, rendering them more susceptible to chronic musculoskeletal complaints. However, the relatively modest strength of these associations indicates that age alone is insufficient to explain the observed variability, emphasizing the primacy of riding-related biomechanical factors[(37–39)].

Marginal Differences and Clinical Significance

The marginal difference analysis constitutes one of the most clinically informative components of this study. Although some absolute differences between groups appeared numerically small, their corresponding percentage differences were substantial, particularly in pain, disability, and HRQoL domains. For instance, sports bikers exhibited markedly higher percentage differences in MOLBPDQ, NDI, and health perception scores compared to non-sports bikers, underscoring the disproportionate burden borne by this subgroup. These findings underscore an important methodological insight: statistical significance alone may obscure clinically meaningful disparities. Marginal differences, when interpreted in relative terms, can reveal patterns of vulnerability that warrant targeted intervention. From a clinical perspective, even modest increases in disability scores may translate into significant functional limitations over time, particularly in activities requiring prolonged sitting, trunk stability, or cervical endurance.

Implications for Prevention and Rehabilitation

The integrative interpretation of these findings carries substantial implications for preventive and rehabilitative strategies. The pronounced vulnerability of sports bikers suggests a need for ergonomic optimization, including handlebar positioning, seat design, and posture education. Strengthening and endurance training targeting the cervical and lumbar stabilizing musculature may mitigate the adverse effects of sustained postural loading. Additionally, vibration-dampening technologies and periodic rest intervals could reduce cumulative mechanical stress. Gender-specific considerations should inform intervention design, acknowledging differences in pain perception, functional priorities, and psychosocial coping mechanisms. Rehabilitation programs that integrate physical conditioning with cognitive-behavioral strategies may be particularly effective in addressing the multifactorial nature of musculoskeletal pain and disability[40–43].

Integrative Perspective

In synthesis, the present findings depict musculoskeletal health among motorcyclists as a dynamic continuum shaped by riding type, anthropometric characteristics, age, and psychosocial context. Sports biking emerges as a salient determinant of pain and disability, while HRQoL outcomes reflect the downstream psychosocial ramifications of physical strain. The nuanced correlation patterns and marginal differences observed in this study advocate for a paradigm shift from symptom-centric assessment toward multidimensional evaluation and personalized intervention. By elucidating these complex interrelationships, the study contributes meaningfully to the existing literature and provides a robust empirical foundation for future longitudinal research, ergonomic innovation, and evidence-based clinical practice aimed at preserving musculoskeletal health in motorcyclists.

V. Conclusion

This study demonstrates that motorcyclists, particularly sports bikers, experience a significant burden of musculoskeletal pain and functional disability, with discernible impacts on health-related quality of life. The intricate associations among pain, disability, and HRQoL underscore the necessity for multidimensional assessment and targeted intervention. Rider-specific and gender-informed preventive and rehabilitative strategies are essential to mitigate long-term musculoskeletal morbidity.

VI. Limitation of the Study

The cross-sectional design precludes causal inference between riding posture and musculoskeletal outcomes. Reliance on self-reported pain and riding exposure may introduce recall bias. The marked gender imbalance limits generalizability to female riders, and the absence of objective biomechanical or vibration measurements restricts mechanistic interpretation of spinal load dynamics.

VII. Future Scope of the Study

Future research should adopt longitudinal designs integrating wearable biomechanical sensors, electromyography, and spinal loading analytics. Large-scale, gender-balanced cohorts are recommended. AI-driven predictive modelling, personalized ergonomic interventions, and intervention-based rehabilitation trials should be explored to mitigate riding-related musculoskeletal burden.

VIII. Acknowledgment

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IX. Conflict of Interest

The authors declare that there is no conflict of interest financial, personal, or professional that could have influenced the conduct, analysis, or reporting of this study.

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Figures and Tables

Table 1: Showing the descriptive statistical scores of the variables in sports bikers without any division.

	Variables	Mean ± S.D.	SE Mean	Skewness	Kurtosis	Cohen's d	t-value	p-value
	Age	25.87 ± 4.61	0.36	0.72	-0.04	5.61	71.4	< 0.001
	Height	174.1 ± 8.58	0.67	0.18	-1.2	20.287	258.21	< 0.001
	Weight	77.91 ± 15.13	1.18	0.18	-1.25	5.149	62.53	< 0.001
	BMI	25.88 ± 5.60	0.44	0.4	-0.58	4.622	58.82	< 0.001
	Pain	5.59 ± 1.30	0.1	-0.59	0.31	4.278	54.45	< 0.001
	MOLBPDQ (%)	30.99 ± 7.58	0.59	-0.48	-0.03	4.087	52.02	< 0.001
	NDI (%)	16.35 ± 7.25	0.57	0.37	-1.03	2.253	28.68	< 0.001
SF -20	**HRQOL-PH**	67.59 ± 11.67	0.91	-0.4	-0.19	5.792	73.72	< 0.001
	HRQOL-RF	58.43 ± 13.05	1.02	-0.3	0.1	4.478	56.99	< 0.001
	HRQOL-SF	48.01 ± 11.53	0.9	-0.02	0.02	4.164	53	< 0.001
	HRQOL-MH	60.55 ± 13.95	1.09	-0.28	0.1	4.341	55.25	< 0.001
	HRQOL-HP	62.17 ± 14.30	1.12	-0.5	0.12	4.347	55.33	< 0.001
	HRQOL-P	56.81 ± 14.21	1.11	-0.27	0.003	3.998	50.88	< 0.001

Table 2: Showing the descriptive statistical scores of the variables in sports bikers with Gender division.

	Variables	Division (Gender)	Mean ± S.D.	SE Mean	Skewness	Kurtosis	Cohen's d	t-value	p-value
	Age	**Females**	22.25 ± 0.50	0.25	2	4	-0.805	-1.59	0.114
		Males	25.96 ± 4.64	0.37	0.68	-0.09			
	Height	**Females**	166.8 ± 8.27	4.13	1.96	3.89	-0.864	-1.706	0.09
		Males	174.2 ± 8.52	0.68	0.18	-1.18			
	Weight	**Females**	83.9 ± 13.74	6.87	1.87	3.57	0.41	0.809	0.42
		Males	77.69 ± 15.20	1.21	0.19	-1.27			
	BMI	**Females**	30.42 ± 6.48	3.24	1.04	1.95	0.832	1.644	0.102
		Males	25.76 ± 5.56	0.44	0.39	-0.63			
	Pain	**Females**	5.5 ± 1.73	0.86	-1.54	2.88	-0.075	-0.148	0.882
		Males	5.59 ± 1.30	0.1	-0.58	0.34			
	MOLBPDQ (%)	**Females**	26.25 ± 9.03	4.51	0.49	1.57	-0.636	-1.256	0.211
		Males	31.06 ± 7.54	0.6	-0.493	0.03			
	NDI (%)	**Females**	23.25 ± 4.99	2.49	-0.103	-5.027	0.978	1.931	0.055
		Males	16.20 ± 7.25	0.57	0.409	-1.007			
SF-20	**HRQOL-PH**	**Females**	68.25 ± 16.50	8.25	0.39	-0.09	0.053	0.105	0.916
		Males	67.62 ± 11.62	0.92	-0.44	-0.15			
	HRQOL-RF	**Females**	73.50 ± 8.54	4.27	-1.042	-0.324	1.196	2.362	0.019
		Males	58.07 ± 12.97	1.03	-0.3	0.13			
	HRQOL-SF	**Females**	57.50 ± 10.21	5.1	-1.35	2.55	0.843	1.666	0.098
		Males	47.82 ± 11.51	0.91	-0.02	0.07			
	HRQOL-MH	**Females**	64.00 ± 18.18	9.09	-0.89	-0.74	0.245	0.483	0.63
		Males	60.59 ± 13.83	1.1	-0.29	0.21			

HRQOL-HP	**Females**	60.50 ± 15.29	7.64	-0.67	-1.45	-0.118	-0.232	0.817
	Males	62.19 ± 14.37	1.14	-0.5	0.13			
HRQOL-P	**Females**	67.75 ± 1.70	0.85	0.75	0.34	0.786	1.552	0.123
	Males	56.63 ± 14.28	1.14	-0.24	0.01			

Table 3: Showing the Correlational Analysis between the Variables with Pearson's and Spearman's Correlation in Sports Bikers.

			Pearson		Spearman	
			r	p	rho	p
Height_cm	-	**BMI**	-0.424***	< .001	-0.383***	< .001
Weight_kg	-	**BMI**	0.887***	< .001	0.900***	< .001
Weight_kg	-	**HRQOL-P**	0.167*	.034	0.172*	.029
Pain	-	**HRQOL-MH**	0.163*	.038	0.128	.104
Pain	-	**HRQOL-HP**	-0.072	.364	-0.126	.109
Pain	-	**HRQOL-P**	0.135	.086	0.156*	.047
MOLBPDQ (%)	-	**NDI (%)**	-0.179*	.023	-0.145	.067
MOLBPDQ (%)	-	**HRQOL- PH**	-0.145	.065	-0.086	.278
MOLBPDQ (%)	-	**HRQOL-RF**	-0.179*	.022	-0.173*	.027
MOLBPDQ (%)	-	**HRQOL-SF**	0.067	.397	0.028	.724
MOLBPDQ (%)	-	**HRQOL-MH**	0.245**	.002	0.304***	< .001
MOLBPDQ (%)	-	**HRQOL-HP**	-0.022	.783	0.032	.687
MOLBPDQ (%)	-	**HRQOL-P**	-0.042	.593	-0.031	.694
NDI (%)	-	**HRQOL- PH**	0.172*	.028	0.137	.083
NDI (%)	-	**HRQOL-RF**	0.115	.146	0.119	.131
NDI (%)	-	**HRQOL-SF**	0.012	.877	0.011	.888
NDI (%)	-	**HRQOL-MH**	-0.009	.909	-0.018	.816
NDI (%)	-	**HRQOL-HP**	0.131	.096	0.121	.124
NDI (%)	-	**HRQOL-P**	0.069	.385	0.083	.294
HRQOL- PH	-	**HRQOL-RF**	0.023	.767	-4.866×10^{-4}	.995
HRQOL- PH	-	**HRQOL-SF**	0.091	.252	0.103	.194
HRQOL- PH	-	**HRQOL-MH**	-0.009	.907	-0.031	.696
HRQOL- PH	-	**HRQOL-HP**	0.017	.833	0.030	.701
HRQOL- PH	-	**HRQOL-P**	-0.045	.569	-0.061	.439
HRQOL-RF	-	**HRQOL-SF**	0.019	.815	0.033	.677
HRQOL-RF	-	**HRQOL-MH**	-0.017	.827	-0.010	.900
HRQOL-RF	-	**HRQOL-HP**	0.046	.561	0.049	.534
HRQOL-RF	-	**HRQOL-P**	0.014	.856	0.054	.494
HRQOL-SF	-	**HRQOL-MH**	0.090	.257	0.098	.215
HRQOL-SF	-	**HRQOL-HP**	-0.144	.067	-0.160*	.041
HRQOL-SF	-	**HRQOL-P**	0.036	.646	0.092	.245
HRQOL-MH	-	**HRQOL-HP**	0.071	.367	0.053	.501
HRQOL-MH	-	**HRQOL-P**	-0.125	.112	-0.134	.090
HRQOL-HP	-	**HRQOL-P**	-0.046	.560	-0.053	.505

* p < .05, ** p < .01, *** p < .001

Table 4:Showing the descriptive statistical scores of the variables in Non-sports bikers without any division.

	Variables	Mean ± S.D.	SE Mean	Skewness	Kurtosis	Cohen's d	t-value	p-value
	Age	28.58 ± 6.38	0.51	0.6	-0.59	4.476	55.91	< 0.001
	Height	174.9 ± 9.69	0.77	0.03	-1.41	18.042	225.35	< 0.001
	Weight	79.65 ± 14.82	1.18	0.09	-1.32	5.373	67.11	< 0.001
	BMI	26.30 ± 5.83	0.46	0.34	-0.57	4.508	56.3	< 0.001
	Pain	4.37 ± 1.47	0.11	0.24	0.14	2.962	36.99	< 0.001
	MOLBPDQ (%)	24.06 ± 8.61	0.69	0.54	-0.37	2.794	34.89	< 0.001
	NDI (%)	18.21 ± 8.47	0.67	-0.04	-0.96	2.147	26.82	< 0.001
SF-20	**HRQOL-PH**	66.85 ± 11.88	0.95	-0.11	-0.94	5.626	70.27	< 0.001
	HRQOL-RF	57.71 ± 12.95	1.03	-0.36	0.56	4.455	55.64	< 0.001
	HRQOL-SF	48.57 ± 11.35	0.9	-0.28	-0.34	4.281	53.46	< 0.001
	HRQOL-MH	61.61 ± 13.03	1.04	-0.34	-0.16	4.73	59.07	< 0.001
	HRQOL-HP	51.61 ± 13.45	1.07	-0.03	-0.01	3.387	47.92	< 0.001
	HRQOL-P	54.80 ± 15.22	1.21	0.1	-0.41	3.602	44.98	< 0.001

Table 5:Showing the descriptive statistical scores of the variables in Non-sports bikers with Gender division.

Variables	Division (Gender)	Mean ± S.D.	SE Mean	Skewness	Kurtosis	Cohen's d	t-value	p-value
Age	**Females**	21.88 ± 0.99	0.35	-0.86	0.84	-1.138	-3.136	0.002
	Males	28.95 ± 6.35	0.52	0.54	-0.63			
Height	**Females**	180.2 ± 12.14	4.29	-1.27	-0.2	0.579	1.595	0.113
	Males	174.6 ± 9.51	0.78	0.08	-1.37			

	Weight	**Females**	72.71 ± 16.11	5.69	1.55	1.37	-0.495	-1.362	0.175
		Males	80.02 ± 14.72	1.21	0.04	-1.3			
	BMI	**Females**	22.82 ± 6.67	2.35	1.19	-0.08	-0.634	-1.747	0.083
		Males	26.49 ± 5.75	0.47	0.34	-0.5			
	Pain	**Females**	4.12 ± 1.12	0.39	0.48	-0.98	-0.18	-0.496	0.62
		Males	4.39 ± 1.49	0.12	0.23	0.12			
	MOLBPDQ (%)	**Females**	21.25 ± 8.15	2.88	0.07	-0.81	-0.344	-0.948	0.344
		Males	24.22 ± 8.63	0.71	0.56	-0.39			
	NDI (%)	**Females**	18.00 ± 10.25	3.62	-0.55	-1.88	-0.025	-0.07	0.944
		Males	18.22 ± 8.41	0.69	-0.007	-0.92			
SF -20	**HRQOL-PH**	**Females**	62.88 ± 13.64	4.82	1.13	-0.2	-0.353	-0.972	0.333
		Males	67.07 ± 11.80	0.97	-0.17	-0.87			
	HRQOL-RF	**Females**	56.63 ± 10.77	3.8	-1.03	1.74	-0.088	-0.241	0.81
		Males	57.76 ± 13.09	1.07	-0.35	0.54			
	HRQOL-SF	**Females**	47.88 ± 7.62	2.69	-0.81	0.42	-0.064	-0.177	0.859
		Males	48.61 ± 11.53	0.94	-0.28	-0.39			
	HRQOL-MH	**Females**	63.75 ± 7.64	2.7	-0.52	-1.74	0.173	0.476	0.635
		Males	61.49 ± 13.26	1.09	-0.32	0.23			
	HRQOL-HP	**Females**	46.38 ± 7.90	2.79	-1.82	3.4	-0.411	-1.131	0.26
		Males	51.89 ± 13.65	1.12	-0.06	-0.07			
	HRQOL-P	**Females**	53.13 ± 14.78	5.22	0.94	1.14	-0.116	-0.319	0.75
		Males	54.89 ± 15.28	1.25	0.07	-0.41			

Table 6: Showing the Correlational Analysis between the Variables with Pearson's and Spearman's Correlation in Non-Sports Bikers.

			Pearson		Spearman	
			r	p	rho	p
AGE	-	**NDI (%)**	0.159*	.047	0.147	.068
AGE	-	**HRQOL-RF**	-0.295***	< .001	-0.298***	< .001
Height_cm	-	**BMI**	-0.534***	< .001	-0.511***	< .001
Height_cm	-	**HRQOL-RF**	0.164*	.041	0.165*	.040
Weight_kg	-	**BMI**	0.865***	< .001	0.877***	< .001
BMI	-	**HRQOL-RF**	-0.198*	.013	-0.196*	.014
NDI (%)	-	**HRQOL-RF**	-0.203*	.011	-0.177*	.027
NDI (%)	-	**HRQOL-SF**	-0.026	.745	0.018	.819
NDI (%)	-	**HRQOL-MH**	-0.078	.335	-0.107	.184
NDI (%)	-	**HRQOL-HP**	-0.045	.581	-0.042	.606
NDI (%)	-	**HRQOL-P**	0.151	.060	0.110	.171
HRQOL- PH	-	**HRQOL-RF**	0.091	.258	0.066	.412
HRQOL- PH	-	**HRQOL-SF**	-0.138	.086	-0.117	.145
HRQOL- PH	-	**HRQOL-MH**	0.034	.673	0.075	.353
HRQOL- PH	-	**HRQOL-HP**	0.030	.706	0.038	.636
HRQOL- PH	-	**HRQOL-P**	-0.055	.493	-0.066	.414
HRQOL-RF	-	**HRQOL-SF**	0.131	.102	0.138	.085
HRQOL-RF	-	**HRQOL-MH**	-0.182*	.023	-0.150	.062
HRQOL-RF	-	**HRQOL-HP**	-0.049	.540	-0.037	.646
HRQOL-RF	-	**HRQOL-P**	0.157	.050	0.096	.235
HRQOL-SF	-	**HRQOL-MH**	-0.028	.733	-0.023	.772
HRQOL-SF	-	**HRQOL-HP**	-0.213**	.008	-0.265***	< .001
HRQOL-SF	-	**HRQOL-P**	0.032	.687	0.040	.618
HRQOL-MH	-	**HRQOL-HP**	0.108	.180	0.073	.363
HRQOL-MH	-	**HRQOL-P**	-0.211**	.008	-0.238**	.003
HRQOL-HP	-	**HRQOL-P**	-0.096	.235	-0.102	.206

* p < .05, ** p < .01, *** p < .001

Table 7: Showing the descriptive statistical scores of the variables in Both Sports & Non-sports bikers without any division.

	Variables	Mean ± S.D.	SE Mean	Skewness	Kurtosis	Cohen's d	t-value	p-value
	Age	27.20 ± 5.70	0.32	0.82	0.02	4.765	84.98	< 0.001
	Height	174.5 ± 9.13	0.51	0.11	-1.3	19.092	340.47	< 0.001
	Weight	78.76 ± 14.98	0.84	0.13	-1.28	5.257	93.74	< 0.001
	BMI	26.09 ± 5.71	0.32	0.37	-0.58	4.568	81.46	< 0.001
	Pain	4.99 ± 1.51	0.08	-0.2	-0.36	3.291	58.68	< 0.001
	MOLBPDQ (%)	27.59 ± 8.80	0.49	-0.03	-0.84	3.134	55.89	< 0.001
	NDI (%)	17.26 ± 9.22	0.44	0.17	-0.99	2.179	38.86	< 0.001
SF-20	**HRQOL-PH**	67.23 ± 11.76	0.66	-0.25	-0.59	5.716	101.75	< 0.001

HRQOL-RF	58.08 ± 12.99	0.72	-0.32	0.3	4.472	79.75	< 0.001
HRQOL-SF	48.28 ± 11.43	0.64	-0.15	-0.18	4.226	75.36	< 0.001
HRQOL-MH	61.07 ± 13.49	0.75	-0.31	-0.01	4.526	80.71	< 0.001
HRQOL-HP	56.99 ± 14.84	0.83	-0.18	-0.28	3.84	68.47	< 0.001
HRQOL-P	55.83 ± 14.72	0.82	-0.08	-0.27	3.791	6.61	< 0.001

Table 8:Showing the descriptive statistical scores of the variables in Both Sports & Non-sports bikers with Gender division.

Variables		Division (Gender)	Mean ± S.D.	SE Mean	Skewness	Kurtosis	Cohen's d	t-value	p-value
Age		**Females**	22.00 ± 0.85	0.24	-1.05	1.92	-0.96	-3.262	0.001
		Males	27.41 ± 5.73	0.32	0.76	-0.05			
Height		**Females**	175.7 ± 12.48	3.6	-0.23	-2.1	0.146	0.497	0.619
		Males	174.4 ± 9.01	0.51	0.136	-1.27			
Weight		**Females**	76.44 ± 15.72	4.53	0.98	-0.21	-0.158	-0.538	0.591
		Males	78.82 ± 14.99	0.85	0.11	-1.29			
BMI		**Females**	25.35 ± 7.33	2.11	0.61	-0.75	-0.134	-0.456	0.649
		Males	26.12 ± 5.66	0.32	0.37	-0.57			
Pain		**Females**	4.58 ± 1.44	0.41	0.23	-1.43	-0.283	-0.96	0.338
		Males	5.01 ± 1.52	0.08	-0.224	-0.329			
MOLBPDQ (%)		**Females**	22.92 ± 8.40	2.42	0.17	-0.45	-0.551	-1.871	0.062
		Males	27.74 ± 8.77	0.5	-0.04	-0.84			
NDI (%)		**Females**	19.75 ± 8.96	2.58	-0.92	-0.61	0.325	1.103	0.271
		Males	17.18 ± 7.88	0.45	0.21	-0.96			
SF-20	**HRQOL-PH**	**Females**	64.67 ± 14.13	4.07	0.76	-0.93	-0.228	-0.775	0.439
		Males	67.35 ± 11.69	0.66	-0.3	-0.53			
	HRQOL-RF	**Females**	62.25 ± 12.76	3.68	-0.51	0.62	0.333	1.131	0.259
		Males	57.92 ± 13.01	0.74	-0.32	0.31			
	HRQOL-SF	**Females**	51.08 ± 9.37	2.7	-0.15	-0.28	0.252	0.857	0.392
		Males	48.20 ± 11.51	0.65	-0.14	-0.18			
	HRQOL-MH	**Females**	63.83 ± 11.29	3.25	-0.67	0.28	0.208	0.707	0.48
		Males	61.03 ± 13.54	0.77	-0.31	0.004			
	HRQOL-HP	**Females**	51.08 ± 12.32	3.55	0.45	0.83	-0.412	-1.399	0.163
		Males	57.19 ± 14.92	0.85	-0.2	-0.27			
	HRQOL-P	**Females**	58.00 ± 13.84	3.99	-0.13	-0.64	0.15	0.51	0.61
		Males	55.79 ± 14.78	0.84	-0.08	-0.26			

Table 9: Showing the descriptive statistical scores of the variables in Both Sports & Non-sports bikers with Bikers division.

Variables		Division (Bikers)	Mean ± S.D.	SE Mean	Skewness	Kurtosis	Cohen's d	t-value	p-value
Age		**Non-Sports**	28.58 ± 6.38	0.51	0.6	-0.59	0.489	4.335	< 0.001
		Sports	25.87 ± 4.61	0.36	0.72	-0.04			
Height		**Non-Sports**	174.9 ± 9.69	0.77	0.03	-1.41	0.091	0.807	0.42
		Sports	174.1 ± 8.58	0.67	0.18	-1.2			
Weight		**Non-Sports**	79.65 ± 14.82	1.18	0.09	-1.32	0.116	1.037	0.301
		Sports	77.91 ± 15.13	1.18	0.18	-1.32			
BMI		**Non-Sports**	26.30 ± 5.83	0.46	0.34	-0.57	0.073	0.655	0.513
		Sports	25.88 ± 5.60	0.44	0.4	-0.58			
Pain		**Non-Sports**	4.37 ± 1.47	0.11	0.24	0.14	-0.871	-7.768	< 0.001
		Sports	5.59 ± 1.30	0.1	-0.59	0.31			
MOLBPDQ (%)		**Non-Sports**	24.06 ± 8.61	0.69	0.54	-0.37	-0.854	-7.616	< 0.001
		Sports	30.99 ± 7.58	0.59	-0.48	-0.03			
NDI (%)		**Non-Sports**	18.21 ± 8.47	0.67	-0.04	-0.96	0.235	2.097	0.037
		Sports	16.35 ± 7.25	0.57	0.37	-1.03			
SF-20	**HRQOL-PH**	**Non-Sports**	66.85 ± 11.88	0.95	-0.11	-0.94	-0.063	-0.56	0.576
		Sports	67.59 ± 11.67	0.91	-0.4	-0.19			
	HRQOL-RF	**Non-Sports**	57.71 ± 12.95	1.03	-0.36	0.56	-0.056	-0.498	0.619
		Sports	58.43 ± 13.05	1.02	-0.3	0.1			

HRQOL-SF	**Non-Sports**	48.57 ± 11.35	0.9	-0.28	-0.34	0.049	0.44	0.66
	Sports	48.01 ± 11.53	0.9	-0.02	0.02			
HRQOL-MH	**Non-Sports**	61.61 ± 13.03	1.04	-0.34	-0.16	0.078	0.7	0.485
	Sports	60.55 ± 13.95	1.09	-0.28	0.1			
HRQOL-HP	**Non-Sports**	51.61 ± 13.45	1.07	-0.03	-0.01	-0.76	-6.776	< 0.001
	Sports	62.17 ± 14.30	1.12	-0.5	0.12			
HRQOL-P	**Non-Sports**	54.80 ± 15.22	1.21	0.1	-0.41	-0.137	-1.22	0.223
	Sports	56.81 ± 14.21	1.11	-0.27	0.003			

Table 10: Showing the Correlational Analysis between the Variables with Pearson's and Spearman's Correlation in Both Sports & Non-Sports Bikers.

			Pearson		Spearman		
			r	p	rho	p	Covariance
AGE	-	Pain	-0.147**	.009	-0.109	.053	-1.274
AGE	-	NDI (%)	0.162**	.004	0.125*	.026	7.323
AGE	-	HRQOL-RF	-0.193***	< .001	-0.172**	.002	-14.343
Height_cm	-	BMI	-0.480***	< .001	-0.447***	< .001	-25.039
Height_cm	-	HRQOL-RF	0.112*	.046	0.090	.109	13.279
Weight_kg	-	BMI	0.876***	< .001	0.889***	< .001	74.979
Pain	-	MOLBPDQ (%)	0.194***	< .001	0.212***	< .001	2.595
Pain	-	HRQOL-HP	0.125*	.025	0.118*	.036	2.823
Pain	-	HRQOL-P	0.135*	.016	0.138*	.014	3.009
MOLBPDQ (%)	-	NDI (%)	-0.176**	.002	-0.183**	.001	-12.249
MOLBPDQ (%)	-	HRQOL-HP	0.117*	.037	0.133*	.018	15.279
HRQOL-RF	-	HRQOL-P	0.088	.117	0.081	.149	16.865
HRQOL-SF	-	HRQOL-MH	0.035	.528	0.045	.428	5.469
HRQOL-SF	-	HRQOL-HP	-0.174**	.002	-0.203***	< .001	-29.463
HRQOL-SF	-	HRQOL-P	0.033	.563	0.058	.306	5.481
HRQOL-MH	-	HRQOL-HP	0.068	.225	0.033	.557	13.670
HRQOL-MH	-	HRQOL-P	-0.169**	.003	-0.180**	.001	-33.550
HRQOL-HP	-	HRQOL-P	-0.041	.464	-0.050	.374	-8.999

* p < .05, ** p < .01, *** p < .001

Table 11: Showing the Descriptive Scores as Marginal Difference Between Genders, Bikers in all the three categorised Sections i.e., Non-Sports, Sports and Combination of Both Types of Bikers.

Marginal Differences between Genders and Bikers in all three Sections of Analysis

Variables	**Sports Bikers**		**Non- Sports Bikers**		**Combine (Gender)**		**Combine (Bikers)**	
	Difference	**Difference (%)**	**Difference**	**Difference (%)**	**Difference**	**Difference (%)**	**Difference**	**Difference (%)**
Age	3.71	53.02	7.07	24.42	5.41	19.73	2.71	9.48
Height	7.4	4.24	5.6	3.1	1.3	0.73	0.08	0.45
Weight	6.21	7.4	7.31	9.13	2.38	3.01	1.74	2.18
BMI	4.66	15.31	3.67	13.85	0.77	2.94	0.42	1.59
Pain	0.09	1.61	0.27	6.15	0.53	10.57	1.22	21.82
MOLBPDQ (%)	4.81	15.48	2.97	12.26	4.82	17.37	6.93	22.45
NDI (%)	7.05	30.32	0.22	1.2	2.57	13.01	1.86	10.21
HRQOL - PH	0.63	0.92	4.19	6.24	2.68	3.97	0.74	1.09
HRQOL - RF	15.43	20.99	1.13	1.95	4.33	6.95	0.72	1.23
HRQOL - SF	9.68	16.83	0.73	1.5	2.88	5.63	0.56	1.15
HRQOL - MH	3.41	5.32	2.26	3.54	2.8	4.38	1.06	1.72
HRQOL - HP	1.69	2.71	5.51	10.61	6.11	10.68	10.56	16.98
HRQOL - P	11.12	16.41	1.76	3.2	2.21	3.81	2.01	3.53