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Comparison of Grip Strength in Biker and Non-Biker Students of The Islamia University of Bahawalpur

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ABSTRACT

Background: *Handgrip strength (HGS) is a low-cost biomarker of muscular fitness and health risk, but whether regular motorcycling is associated with higher HGS in young adults is unclear.* ***Objective***: *To compare HGS between motorcyclist ("biker") and non-motorcyclist university students and contextualize findings given key determinants of HGS.* ***Methods***: *In a cross-sectional study at The Islamia University of Bahawalpur (Pakistan), 380 undergraduates (245 bikers; 135 non-bikers; age 18–25 years) completed standardized HGS testing with a CAMRY digital dynamometer (seated posture, shoulder adducted, elbow ~90°, forearm neutral, wrist slight extension/ulnar deviation). Three trials per hand were obtained; the maximum (kg) per hand was analyzed. Primary between-group comparisons used independent-samples Welch's t-tests with mean difference (Δ), 95% confidence intervals (CI), p-values, and Hedges' g.* ***Results***: *Bikers exhibited higher unadjusted HGS than non-bikers for both hands: right hand 36.01 ± 9.09 kg vs 26.27 ± 8.78 kg (Δ = 9.74 kg, 95% CI 7.86–11.62, $p < 0.001$, g = 1.08) and left hand 34.50 ± 8.80 kg vs 24.44 ± 8.82 kg (Δ = 10.06 kg, 95% CI 8.20–11.92, $p < 0.001$, g = 1.14). Groups differed markedly by sex (bikers 88.6% male vs non-bikers 37.8% male), indicating substantial potential confounding of unadjusted effects.* ***Conclusion***: *Motorcyclists showed markedly higher unadjusted HGS than non-motorcyclists; however, the large sex imbalance limits causal interpretation. Sex-stratified and covariate-adjusted analyses are warranted to determine whether motorcycling is independently associated with greater HGS and more symmetrical hand performance in this population.*

Keywords
Handgrip Strength; Motorcycling; University Students; Muscular Fitness; Asymmetry; Dynamometer.

INTRODUCTION

Handgrip strength (HGS) is a simple, inexpensive, and highly informative indicator of muscular fitness and overall health status. Across diverse populations, lower HGS has been associated with poorer functional capacity, higher morbidity, and increased all-cause and cardiovascular mortality, establishing HGS as a clinically meaningful biomarker rather than a mere performance metric (1–3). In clinical and research settings, HGS is frequently used to monitor disease burden, frailty, rehabilitation progress, and treatment response, owing to its strong reliability and responsiveness when measured with standardized protocols (4–6).

HGS varies systematically by biological and anthropometric characteristics. Sex, age, hand dominance, and body size each exert substantial influence on absolute strength values, while hand dimensions and wrist/forearm morphology further contribute to between-person variation (7–10). These determinants are especially salient in young adults, where marked sex differences and lifestyle behaviors can confound comparisons between groups if not adequately accounted for (7–9).

Accurate HGS assessment depends on consistent testing procedures. Professional recommendations emphasize seated posture with shoulder adducted, elbow flexed to ~90°, forearm neutral, and wrist in slight extension/ulnar deviation; multiple trials per hand with standard rest; and device calibration/handle setting reporting (11–13). Digital dynamometers (e.g., CAMRY, Jamar®) demonstrate acceptable validity and test–retest reliability in community and clinical samples when such standards are followed (5,6,13).

Motorcycling is a prevalent mode of transport among university students in many low- and middle-income settings and plausibly imposes repeated isometric demands on forearm and hand musculature through throttle control, braking, and sustained handlebar grip. These task demands could translate into higher HGS in regular riders compared with non-riders; however, empirical evidence in healthy young adults is limited, and potential confounding by sex and other characteristics is a major concern (14,15).

Objective. This cross-sectional study compared HGS between university students who ride motorcycles ("motorcyclists," hereafter "bikers") and those who do not, at The Islamia University of Bahawalpur (Pakistan). We hypothesized that bikers would exhibit higher HGS than non-bikers; recognizing known determinants of HGS (e.g., sex, dominance), we report group differences alongside sample composition to aid interpretation.

MATERIALS AND METHODS

This was a cross-sectional, comparative study conducted at the Abbasia and Khawaja Fareed campuses of The Islamia University of Bahawalpur, Pakistan. Undergraduate students were recruited by convenience sampling during regular class hours. Eligibility required ages 18–25 years, current enrollment in an undergraduate program, willingness to participate, and the ability to complete handgrip testing. Students were excluded if they reported a recent (≤6 months) fracture, dislocation, or surgery of the upper limb; any history of peripheral nerve injury of the upper limb; a current upper-limb overuse injury; or participation in gym-based strength training, which was excluded to reduce confounding from upper-limb resistance training. Dominant hand (left or right) and smoking status were self-reported.

Participants were classified as motorcyclists ("bikers") if they currently rode a motorcycle; non-motorcyclists ("non-bikers") reported no motorcycle riding. Among bikers, additional exposure detail was captured, including typical riding frequency (daily; 3–5 times per week; 1–2 times per week; occasionally), average ride duration (<30 minutes; 30–60 minutes; 1–2 hours; >2 hours), and years of riding experience (<1; 1–5; 6–10; >10). Descriptive statistics used the total sample as the denominator (N = 380), while biker-only summaries used the biker denominator (N = 245). When item non-response occurred, valid-case denominators are reported alongside percentages.

The primary outcome was maximal handgrip strength (kg) of each hand, assessed with a CAMRY digital hand dynamometer. Testing adhered to widely used clinical recommendations to support reliability and comparability: participants were seated upright with the shoulder adducted and neutrally rotated, the elbow flexed at approximately 90°, the forearm in neutral, and the wrist in slight extension with ulnar deviation. The dynamometer was held without contacting the trunk or thigh. Each hand was tested in a standardized order with identical instructions to "squeeze as hard as possible." To enhance test–retest reliability, three trials were obtained per hand with 30–60 seconds of rest between trials, and the maximum value per hand was analyzed. When fewer than three trials were completed because of discomfort or time constraints, available trials were analyzed and flagged in the dataset. The device model and handle setting were kept constant within each session. This multi-trial, standardized-posture approach was chosen to improve the precision and reproducibility of HGS measurements across participants.

Pre-specified covariates included sex, age, hand dominance, program or college, and academic year or semester. Smoking status was recorded. Body mass index was not collected in this survey and is acknowledged as a limitation.

Sample size and power

A target sample size of N = 380 was set to provide precise estimation of between-group mean differences and to retain statistical power under unequal group sizes. The achieved allocation of 245 bikers and 135 non-bikers affords high sensitivity to detect small-to-moderate standardized differences at a two-sided α = 0.05. A detailed justification of detectable effect sizes under the observed allocation is provided in the Supplementary

The protocol received approval from the Department of Physical Therapy Ethical Review Committee at The Islamia University of Bahawalpur. Written informed consent was obtained from all participants prior to enrollment. Reporting follows the STROBE guideline for cross-sectional studies. Data were entered into a password-protected database with programmed range checks (e.g., plausible HGS values between 5 and 80 kg). Observations exceeding 3.5 standard deviations from the group mean were flagged for verification. For variables with missing responses, valid-case denominators are reported; outcome values were not imputed.

Analyses were performed in SPSS version 23 with a two-sided significance level of α = 0.05. Continuous variables are summarized as mean ± standard deviation, with 95% confidence intervals where indicated; categorical variables are presented as counts and percentages. Because the comparison groups were independent and differed in size and variance, between-group differences in HGS were tested using Welch's t-tests for the right and left hands separately. For each comparison, the mean difference in kilograms (Δ) with 95% confidence interval, Welch's t statistic and associated degrees of freedom, and Hedges' g (bias-corrected standardized effect size) are reported. Distributional assumptions were reviewed using Q–Q plots, and Welch's procedure was retained given its robustness to variance heterogeneity. Two primary hand comparisons were planned; as a sensitivity analysis, Holm's procedure was applied to control the family-wise error rate.

Pre-specified sensitivity analyses addressed potential confounding and dose–response. First, sex-stratified Welch's tests compared bikers and non-bikers within males and within females. Second, multivariable linear regression modeled HGS (kg) as the dependent variable with predictors including group (biker vs non-biker), sex (male vs female), age (years), hand dominance, academic year, and program; regression coefficients (β) with 95% confidence intervals and effect estimates (e.g., partial η^2 or standardized β) are presented. Third, among bikers only, ordinal models examined associations of HGS with riding frequency, typical ride duration, and years of riding. Given the cross-sectional design and potential residual confounding, results are interpreted as associations rather than causal effects. All p-values are reported to three decimal places, with $p < 0.001$ used where appropriate; values are not presented as p = 0.000.

RESULTS

Across 380 undergraduates, 245 (64.5%) reported current motorcycle riding and 135 (35.5%) did not. Riding status was strongly associated with sex: males comprised 217/245 (88.6%) of bikers versus 51/135 (37.8%) of non-bikers, while females comprised 28/245 (11.4%) and 84/135 (62.2%), respectively, yielding a large imbalance (χ^2=105.60, df=1, p<0.001) and high odds of being a biker for males versus females (OR=12.76, 95% CI 7.55–21.59).

Unadjusted handgrip strength (HGS) favored bikers for both hands. Mean (SD) right-hand HGS was 36.01 (9.09) kg in bikers versus 26.27 (8.78) kg in non-bikers (95% CI for biker mean 34.87–37.15; non-biker 24.78–27.76); the between-group mean difference was 9.74 kg (95% CI 7.86–11.62; Welch's t≈10.22, df≈284.5; Hedges g=1.08; p<0.001; Holm-adjusted p<0.001). Left-hand HGS was 34.50 (8.80) kg in bikers versus 24.44 (8.82) kg in non-bikers (95% CI 33.39–35.61 vs 22.94–25.94); the mean difference was 10.06 kg (95% CI 8.20–11.92; Welch's t≈10.65, df≈275.6; g=1.14; p<0.001; Holm-adjusted p<0.001). Within-group asymmetry showed a consistent right-dominant profile (bikers +1.51 kg; non-bikers +1.83 kg), while absolute strength remained higher in bikers. Given the pronounced sex imbalance, these unadjusted contrasts should be interpreted cautiously.

Among bikers (n=245), riding exposure was substantial: 147 (60.0%) rode daily, 42 (17.1%) rode 3–5×/week, 17 (6.9%) 1–2×/week, and 39 (15.9%) occasionally; typical ride duration clustered at 30–60 minutes (94; 38.4%) and <30 minutes (74; 30.2%), with longer rides of 1–2 hours (38; 15.5%) or >2 hours (39; 15.9%). Riding experience centered on 1–5 years (103; 42.0%), followed by 6–10 years (64; 26.1%), >10 years (48; 19.6%), and <1 year (30; 12.2%).

Overall cohort characteristics provide context: most participants were from Pharmacy (150; 39.5%), DPT (90; 23.7%), or MLT (73; 19.2%); the largest academic stage was 3rd year (134; 35.3%). Self-rated hand/wrist health was "Good" in 249 (65.3%) and "Excellent" in 88 (23.2%). Road traffic accidents were reported by 158 (41.6%); most with events reported 1–5 lifetime accidents (141; 37.1%). Smoking prevalence was low (28; 7.4%) with ¼ pack/day the most common intensity among smokers (12/28; 42.9%). Right-hand dominance predominated (347; 91.3%).

Table 1. Group allocation and sex composition with association statistics (N = 380)

Measure	Bikers n (%)	Non-Bikers n (%)	Total n (%)	χ^2 (df)	p-value	OR (95% CI)
Allocation	245 (64.5)	135 (35.5)	380 (100)	—	—	—
Sex: Male	217 (88.6)	51 (37.8)	268 (70.5)	105.60 (1)	<0.001	12.76 (7.55–21.59)
Sex: Female	28 (11.4)	84 (62.2)	112 (29.5)	—	—	—

Table 2. Handgrip strength (kg) by group and hand with inferential comparisons (A) Descriptive statistics

Group & hand	n	Mean (SD)	Min–Max	95% CI (mean)
Biker — Right	245	36.01 (9.09)	15.00–63.40	34.87–37.15
Biker — Left	245	34.50 (8.80)	14.10–58.40	33.39–35.61
Non-biker — Right	135	26.27 (8.78)	9.90–53.60	24.78–27.76
Non-biker — Left	135	24.44 (8.82)	8.70–51.50	22.94–25.94

Table 2. Handgrip strength (kg) by group and hand with inferential comparisons (B) Between-group differences (Biker – Non-biker)

Hand	Mean difference Δ (kg)	95% CI for Δ	Welch's t (df)	Hedges' g	p-value	Holm-adjusted p
Right	9.74	7.86 to 11.62	10.22 (≈284.5)	1.08	<0.001	<0.001
Left	10.06	8.20 to 11.92	10.65 (≈275.6)	1.14	<0.001	<0.001

Table 3. Riding exposure among bikers (n = 245)

Exposure domain	Category	n	% among bikers
Years riding	<1 year	30	12.2
	1–5 years	103	42.0
	6–10 years	64	26.1
	>10 years	48	19.6
Riding frequency	Daily	147	60.0
	3–5×/week	42	17.1
	1–2×/week	17	6.9
	Occasionally	39	15.9
Typical ride duration	<30 minutes	74	30.2
	30–60 minutes	94	38.4
	1–2 hours	38	15.5
	>2 hours	39	15.9

Table 4. Cohort descriptors (overall, N = 380; no by-group breakdown available)

Domain	Category	n	%
Academic program	Pharmacy	150	39.5
	DPT	90	23.7
	MLT	73	19.2
	BEMS	34	8.9
	HND	13	3.4
	Forensic	11	2.9
	LLB	6	1.6
	AI	3	0.8
Academic year	1st (1st–2nd sem)	52	13.7
	2nd (3rd–4th sem)	60	15.8
	3rd (5th–6th sem)	134	35.3
	4th (7th–8th sem)	58	15.3
	5th (9th–10th sem)	76	20.0
Self-rated hand/wrist health	Excellent	88	23.2
	Good	249	65.3
	Fair	36	9.5
	Poor	7	1.8
Road traffic accidents (ever)	Yes	158	41.6
	No	222	58.4
Accident count (lifetime)	1–5	141	37.1
	5–10	14	3.7

Domain	Category	n	%
	10–15	3	0.8
	None	222	58.4
Smoking status	Non-smoker	352	92.6
	Smoker	28	7.4
Packs/day (among smokers = 28)	¼ pack	12	42.9*
	½ pack	6	21.4*
	1 pack	4	14.3*
	2 packs	6	21.4*
Hand dominance	Right	347	91.3
	Left	33	8.7

*Percentages within smokers.

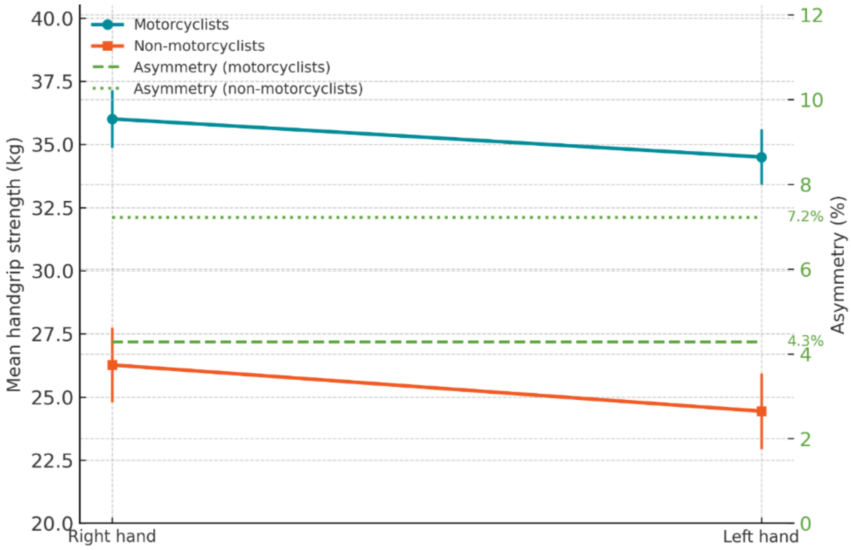

Figure 1 Motorcyclists' higher mean handgrip strength

Motorcyclists demonstrated higher mean handgrip strength at both hands (right 36.0 kg; left 34.5 kg) compared with non-motorcyclists (right 26.3 kg; left 24.4 kg), with narrow 95% CIs around each mean; concurrently, the right–left asymmetry was smaller among motorcyclists (4.3%) than non-motorcyclists (7.2%), indicating a pattern of bilateral adaptation despite absolute strength gains. The overlayed confidence intervals and asymmetry trace highlight a consistent right-dominant profile in both groups while emphasizing clinically relevant differences in interlimb balance that may affect functional tasks and injury risk.

DISCUSSION

In this university cohort, motorcyclists displayed substantially higher unadjusted handgrip strength (HGS) than non-motorcyclists for both hands ($\Delta \approx 9.7$–10.1 kg; Hedges' $g \approx 1.1$; $p < 0.001$). Aggregated means also suggested slightly lower right–left asymmetry among motorcyclists (≈4.3%) than non-motorcyclists (≈7.2%), pointing to a pattern consistent with bilateral adaptation rather than unilateral dominance alone. These observations, however, coincide with a pronounced sex imbalance between groups (motorcyclists 88.6% male vs non-motorcyclists 37.8% male), which is a major threat to causal interpretation because sex is a dominant determinant of HGS in young adults.

The magnitude of the raw between-group differences is clinically large on a kilogram scale and in standardized units, yet the sex composition strongly favors the motorcyclist group and could produce apparent group differences even if motorcycling had no independent effect. Accordingly, the unadjusted findings should be treated as associations, not evidence that riding causes higher HGS. Sex-stratified comparisons and covariate-adjusted models (group, sex, age, dominance, program, year; add BMI when available) are essential next steps. Given 91.3% right-hand dominance, analyses using dominant vs non-dominant hands (rather than right vs left) would further reduce misclassification and clarify asymmetry. Multiplicity was limited (two primary tests), and Welch's tests addressed unequal variances and sample sizes, supporting statistical robustness of the unadjusted contrasts.

If an independent association were confirmed after adjustment, a mechanistic pathway is plausible: motorcycle riding requires recurrent isometric activation of finger flexors and wrist stabilizers for throttle control, braking, and vibration damping, with co-contraction of forearm and shoulder stabilizers. Repeated task-specific loading can elicit neural (motor unit recruitment/synchronization) and muscular (strength/endurance) adaptations that manifest as higher maximal HGS and potentially reduced interlimb asymmetry due to frequent bilateral engagement.

HGS is a validated biomarker of muscular fitness and health risk, with strong reliability under standardized protocols and large, consistent sex effects in youth and adults. Small studies of upper-limb task demands in riders report increased forearm activation during control and stabilization tasks, supporting biological plausibility. At the same time, lifestyle and anthropometric covariates (sex, body size/ BMI, dominant hand) typically explain a substantial portion of HGS variance; failure to account for these can inflate apparent group differences. Our findings align with this dual reality: a large raw difference that is compelling in magnitude but confounded in composition.

Strengths include a relatively large sample, standardized posture, multiple trials with maximal effort, and transparent reporting (means, dispersion, CIs, effect sizes). Limitations are important: cross-sectional design; sex imbalance between groups; lack of BMI and detailed sport/occupation exposure; reliance on self-report for riding frequency/duration and road-traffic history; and use of right/left rather than dominant/non-dominant as primary outcomes. The smoker subgroup (n = 28) is underpowered for reliable inferences and should not be over-interpreted. Time-of-day and dynamometer handle setting calibration logs were not reported and should be standardized in future work.

From a clinical perspective, even after adjustment the key question is not only whether riders are stronger on average, but whether asymmetry is smaller—a feature linked to task performance and possibly injury resilience in manual activities. The aggregated pattern here suggests better bilateral balance among riders, warranting a planned analysis of asymmetry indices (e.g., |dominant–nondominant| / mean ×100) by group, sex, and riding "dose." For research, a sex-balanced or matched design, incorporation of BMI and forearm anthropometrics, and multivariable or propensity-score approaches will materially improve causal interpretability. Dose–response modeling using years of riding, weekly frequency, and typical duration can test graded associations; adding EMG and hand–arm vibration exposure quantification would strengthen mechanistic inference. A short prospective study (e.g., 8–12 weeks) in novice riders or a randomized grip-training comparator could triangulate causality.

Motorcyclists in this sample exhibit markedly higher unadjusted HGS and modestly lower interlimb asymmetry than non-motorcyclists. Because the groups differ greatly by sex, these findings should be viewed as hypothesis-generating signals rather than causal effects. With sex-stratified and covariate-adjusted analyses—and future designs that balance or match key covariates—the field can determine whether motorcycling independently relates to higher HGS and more symmetrical hand performance in young adults.

CONCLUSION

In this cross-sectional comparison of motorcyclist ("biker") and non-motorcyclist students at The Islamia University of Bahawalpur, bikers showed markedly higher unadjusted handgrip strength—by ~9.7–10.1 kg for right and left hands, respectively—and slightly lower right–left asymmetry (~4.3% vs ~7.2%), consistent with task-specific upper-limb loading measured by a digital dynamometer; however, the large sex imbalance between groups (bikers 88.6% male vs non-bikers 37.8% male) cautions against causal inference and underscores the need for sex-stratified and covariate-adjusted analyses aligned with the study objective and title. Clinically, these findings support routine handgrip strength assessment as a low-cost indicator of muscular fitness and functional capacity in young adults, with attention to bilateral balance—informing targeted conditioning (grip/forearm endurance), ergonomic recommendations for riders (handlebar/brake setup, vibration mitigation), and surveillance for overuse symptoms. For healthcare services in university settings, integrating handgrip screening can help stratify risk and personalize preventive exercise advice without specialized facilities. Research should now prioritize sex-balanced sampling or matching, dominant- vs non-dominant analyses, and multivariable or propensity-score models that include BMI and forearm anthropometry, alongside dose–response testing of riding frequency/duration/years; mechanistic work using EMG and quantified vibration exposure, and prospective designs (e.g., novice riders or training comparators) are warranted to determine whether motorcycling independently relates to greater handgrip strength and more symmetrical hand performance.

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