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INTERLIMB STRENGTH AND POWER CHARACTERISTICS IN LONGBOARD AND STREET SKATEBOARDERS: A PILOT EXPLORATORY STUDY

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ABSTRACT

Introduction: Skateboarding, recently included in the Olympic Games, requires substantial lower-limb strength and power. Due to its unilateral pushing mechanics, concerns have been raised regarding the potential development of interlimb asymmetries. Aim: This pilot exploratory study examined potential interlimb differences in strength and power among recreational skateboarders practicing longboard and street modalities. Materials and Methods: Ten male skateboarders (24.34 ± 3.56 years), with at least 24 months of experience, participated. Maximal voluntary isometric contraction (MVIC), one-repetition maximum (1RM), and muscle power at 70% of 1RM were assessed unilaterally in randomized order. Given the small sample size (n = 5 per group), analyses were interpreted cautiously, with emphasis on descriptive patterns and effect sizes. Results: The longboard group demonstrated higher dynamic strength (1RM) and average power values compared to the street group ($p \leq 0.005$). No statistically significant interlimb differences were detected within either modality. However, the study was not powered to confirm true symmetry. Conclusion: Recreational longboard practitioners exhibited higher lower-limb strength and power values than street practitioners. Although no significant interlimb differences were observed, the limited sample size precludes definitive conclusions regarding muscular symmetry. Findings should be interpreted as preliminary and hypothesis-generating.

Key words: Skateboarding. Muscular asymmetry. Strength. Power. Modalities.

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RESUMO

Características de força e potência entre membros inferiores em praticantes de longboard e skate street: um estudo piloto exploratório

Introdução: O skate, recentemente incorporado aos Jogos Olímpicos, exige níveis substanciais de força e potência dos membros inferiores. Considerando que sua execução técnica envolve ações unilaterais repetitivas de impulsão, tem-se levantado a hipótese de possível desenvolvimento de assimetrias musculares entre os membros. Objetivo: Este estudo piloto exploratório investigou possíveis diferenças entre membros inferiores sobre força e potência em praticantes recreacionais das modalidades longboard e street. Materiais e Métodos: Dez skatistas do sexo masculino (24,34 ± 3,56 anos), com pelo menos 24 meses de prática, foram avaliados. A contração voluntária isométrica máxima (CVIM), a força dinâmica máxima (1RM) e a potência muscular a 70% de 1RM foram mensuradas unilateralmente em cadeira extensora, com ordem randomizada. Devido ao reduzido tamanho amostral (n = 5 por grupo), as análises estatísticas foram interpretadas com cautela, com maior ênfase nos dados descritivos e nos tamanhos de efeito. Resultados: O grupo longboard apresentou valores superiores de força dinâmica (1RM) e potência média em comparação ao grupo street ($p \leq 0,005$). Não foram detectadas diferenças estatisticamente significativas entre a perna de impulsão e a perna de apoio em nenhuma modalidade. Entretanto, o estudo não possui poder estatístico suficiente para confirmar equivalência inter membros. Conclusão: Praticantes recreacionais de longboard apresentaram maiores níveis de força e potência. A ausência de diferenças significativas entre membros deve ser interpretada como achado preliminar e exploratório.

Palavras-chave: Skateboarding. Assimetria muscular. Força. Potência. Modalidade.

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INTRODUCTION

Skateboarding has gained increasing visibility in both recreational and competitive contexts, consolidating its position as a globally expanding sport (Kellett, Russell, 2009).

Its recent inclusion in the Olympic Games has further stimulated interest among athletes, coaches, and researchers, contributing to its recognition within high-performance sport settings (Armbrust, Lauro, 2010; Ellmer et al., 2020).

The main skateboarding disciplines include street, longboard, freestyle, and downhill, which differ in equipment characteristics, practice environments, and technical demands (Confederação Brasileira de Skateboarding, 2025).

Regardless of modality, skateboarding requires substantial lower-limb strength, balance control, and neuromuscular coordination (Diewald et al., 2024; Kaewcham, Tongtako, 2024).

A defining technical characteristic of skateboarding is the repetitive unilateral pushing action, in which one limb generates propulsion while the contralateral limb remains stabilized on the board.

This movement pattern may expose the lower limbs to different mechanical and neuromuscular demands (Ellmer et al., 2020; Kamiński, Cygańska, 2024).

Exploratory investigations have described lower-limb force and power characteristics in skateboarders (Candotti et al., 2012), yet the extent to which such unilateral demands translate into measurable interlimb differences remains unclear.

Although asymmetry has been associated with injury occurrence in certain sports (Brudvik, 2006; Shuman, Meyers, 2015; Rodríguez-Rivadulla et al., 2020), direct evidence linking interlimb strength differences to injury risk in skateboarding is currently limited. In other athletic populations, interlimb asymmetry has been examined as a potential performance and injury-related marker (Kalata et al., 2020; İnce, Tortu, 2024).

However, comparable data in skateboarding remain scarce, particularly when considering different modalities.

Therefore, this pilot exploratory study aimed to examine potential interlimb differences in lower-limb strength and power among recreational skateboarders practicing longboard and street modalities.

Given the limited sample size and the cross-sectional design, the investigation was intended to generate preliminary evidence rather than to test confirmatory hypotheses regarding muscular asymmetry.

MATERIALS AND METHODS

Study design

This pilot exploratory observational study was conducted in the physical education department at the Federal University of Viçosa. Ethical approval was obtained from the institutional research ethics committee in UFV (CAAE: 60195722.2.0000.5153; n: 5.664.642). All procedures complied with the principles outlined in the Declaration of Helsinki (World Medical Association, 2013) and with Brazilian National Health Council Resolution 466/12 (Novoa, 2014). All participants provided written informed consent prior to participation.

Volunteers were recruited through announcements distributed via institutional media channels (radio and email) of the Federal University of Viçosa. A convenience sample of ten healthy young adults was enrolled. Participants were recreationally active skateboarders but not engaged in structured resistance training. Based on their self-reported primary modality, participants were allocated into two groups: longboard (n = 5) and street (n = 5). The use of convenience sampling and the small sample size limit external validity and increase susceptibility to selection bias.

Inclusion criteria were: (1) male sex, aged 18-40 years; (2) at least two years of skateboarding experience; (3) availability to complete all procedures; and (4) absence of medical contraindications to exercise. Only male participants were included to reduce biological variability in this preliminary investigation; however, this restricts generalizability. Exclusion criteria were: (1) participation in lower-limb resistance training within the previous 12 months; (2) positive response to any item of the Physical Activity Readiness Questionnaire; and (3) use of medications that could affect neuromuscular performance.

All procedures were completed during a single laboratory visit. Anthropometric measurements were recorded, followed by unilateral strength assessments according to a previously described protocol (Martins et al., 2022).

The single-session design may have increased susceptibility to cumulative fatigue effects.

Assessment of muscle asymmetry

Interlimb asymmetry was operationally defined as the relative difference in performance between the pushing and supporting legs. For each variable (MVIC, 1RM, average power, and peak power), an asymmetry index was calculated using the following formula:

$$\textbf{Asymmetri Index}\ (\%) = \frac{(\textbf{Pushing} - \textbf{Supporting})}{\textbf{0.5 x}\ (\textbf{Pushing} + \textbf{Supporting})}\ \textbf{x 100}$$

This approach allows standardized quantification of interlimb differences independent of absolute strength levels.

Strength manifestations of the lower limbs were assessed unilaterally using a knee extension machine (BH Fitness Nevada Pro-T). The order of limb testing was randomized to minimize potential learning effects or systematic fatigue bias.

For maximal voluntary isometric contraction (MVIC), a load cell (MK, model CSL/ZL-1 T, MK Control, Brazil; sampling frequency 1000 Hz) was coupled to the machine. Participants performed a 5-second maximal isometric contraction at 90° of knee flexion, measured with a goniometer. Two trials were conducted per limb with a two-minute rest interval; the highest value was retained for analysis.

One-repetition maximum (1RM) testing followed standardized unilateral procedures. A warm-up of four repetitions at approximately 50% of MVIC was performed. Perceived exertion was monitored using the OMNI-RES scale (Robertson et al., 2003; Gearhart et al., 2011).

Load increments were progressively applied until the participant completed only one repetition, with two-minute rest intervals and a maximum of five attempts.

Muscle power was assessed at 70% of 1RM using a linear position transducer (Chronojump Encoder, Barcelona, Spain; 1000 Hz).

This relative load was selected to standardize testing intensity across participants, although it may not represent the individual optimal power load. Participants performed one set of three repetitions per limb, executing the concentric phase as fast as possible. The best repetition was used for analysis. The use of a single set may have reduced measurement reliability and should be considered when interpreting results.

Statistical analysis

All variables were initially examined using descriptive statistics (mean ± standard deviation). Interlimb asymmetry was quantified for each outcome (MVIC, 1RM, average power, and peak power) using the Asymmetry Index (AI, %).

Data normality was assessed using the Shapiro-Wilk test. Homogeneity of covariance matrices was evaluated using Box's M test, and sphericity assumptions were examined using Mauchly's test. When violations were detected, appropriate corrections were applied.

Intragroup and intergroup comparisons were conducted using general linear models with multivariate analysis of variance (MANOVA), including two fixed factors: leg (pushing vs. supporting) and group (longboard vs. street). The leg factor examined interlimb differences within each modality, whereas the group factor assessed differences between longboard and street practitioners. Bonferroni adjustments were applied for post hoc comparisons.

Effect sizes were estimated using partial eta squared (η^2) to quantify the magnitude of observed effects. Values of 0.01, 0.06, and 0.14 were interpreted as small, moderate, and large, respectively. Given the small sample size (n = 5 per group), statistical inferences were interpreted cautiously, with emphasis placed on effect sizes and descriptive trends in addition to p-values.

Baseline group comparisons were performed using Student's t test with Welch's correction to account for potential heterogeneity of variances in small samples. All analyses were conducted using SPSS version 22.0.

RESULTS

Table 1 presents the characteristics of the sample participants, showing that there were no statistically significant differences between the groups (p>0.05).

Table 2 presents the intragroup comparisons (pushing vs. supporting leg) and

intergroup comparisons (longboard vs. street) for the different manifestations of lower-limb strength. Regarding intergroup comparisons, participants in the longboard group demonstrated significantly greater maximal dynamic strength (1RM) compared to the street group ($F=10.46$; $p=0.005$; $\eta^2=0.40$), indicating a large effect size. Specifically, the pushing leg in the longboard group reached 145.83 ± 13.93 kg, whereas the corresponding value in the street group was 118.75 ± 19.31 kg.

Table 1 - Characterization of the sample of young adults who practice skateboarding.

	Longboard (n=5)	Street (n=5)	p
Age (years)	24.68 ± 2.75	23.70 ± 4.85	0.707
Body mass (kg)	60.02 ± 9.68	63.11 ± 8.53	0.607
Height (m)	1.63 ± 0.07	1.62 ± 0.07	0.827
BMI (kg/m^2)	22.45 ± 3.27	24.08 ± 4.14	0.510
Practice time (months)	30.57 ± 3.75	28.00 ± 0.01	0.200

Data are presented as mean ± standard deviation. Units: kg – kilogram; m – meter; kg/m^2 – kilogram per meter squared.

Similarly, significant intergroup differences were observed for average power ($F = 17.30$; $p = 0.001$; $\eta^2 = 0.52$), also reflecting a large effect. The longboard group exhibited higher values in both the pushing leg (326.62 ± 45.03 W) and supporting leg (299.87 ± 44.60 W) compared to the street group (240.08 ± 29.54 W and 239.65 ± 20.04 W, respectively). No significant intergroup differences were found for MVIC or peak power ($p>0.05$).

For intragroup comparisons (leg factor), no statistically significant differences were detected between the pushing and supporting legs for any variable ($p>0.05$). The Asymmetry Index (%) values were generally low to moderate across outcomes, reinforcing the absence of statistically detectable interlimb asymmetry within either modality. Collectively, these findings indicate modality-dependent differences in strength and power performance, without evidence of meaningful functional asymmetry between limbs in recreational practitioners.

Table 2 - Intragroup (rowing with support) and intergroup (Longboard vs. Street) comparison in the different manifestations of muscular strength of the lower limbs.

	Longboard			Street			Leg fator (rowing x support)			Group factor (*longboard* x *street*)		
	Leg			Leg								
	Rowing	Support		Rowing	Support							
	Mean±SD	Mean±SD	AI (%)	Mean±SD	Mean±SD	AI (%)	F	p	η^2	F	p	η^2
MVIC (kg)	80.32 ± 15.10	68.55 ± 9.78	15.8%	71.68 ± 14.12	63.08 ± 14.10	12.8%	2.83	0.112	0.15	1.36	0.261	0.08
1RM (kg)	145.83 ± 13.93*	132.50 ± 12.94	9.6%	118.75 ± 19.31	116.25 ± 13.15	2.1%	1.40	0.255	0.08	10.46	0.005	0.40
PM (watts)	326.62 ± 45.03*	299.87 ± 44.60*	8.5%	240.08 ± 29.54	239.65 ± 20.04	0.18%	0.59	0.452	0.04	17.30	0.001	0.52
PP (watts)	637.53 ± 92.91	573.77 ± 112.38	10.5%	467.78 ± 109.59	555.75 ± 210.86	17.2%	0.04	0.842	0.01	2.46	0.137	0.13

Data were presented as mean ± standard deviation. Abbreviation: MVIC – maximum isometric voluntary contraction; 1RM – one repetition maximum; PM – average power; PP – peak power; kg – kilogram; IA - Asymmetry Index; *: statistically significant difference ($p<0.05$) for comparison with the same leg of the Street Group.

DISCUSSION

The present study aimed to investigate the presence of muscular asymmetries in the lower limbs of recreational practitioners of the longboard and street modalities, as well as to compare strength and power performance between these modalities.

The main findings were: (1) significantly higher levels of maximal dynamic strength and average power in the longboard group compared to the street group; and (2) no significant differences between limbs (supporting and pushing legs) within each group.

The observed intergroup differences may be attributed to the specific mechanical and neuromuscular demands of each modality. Competitive skateboarding presents distinct physical and technical requirements depending on the discipline (Diewald et al., 2024).

Longboarding typically involves longer and more continuous displacement, requiring a higher volume and frequency of propulsion actions. Repeated exposure to dynamic loading is known to promote both neural and morphological adaptations, including enhanced motor unit recruitment and coordination (Folland, Williams, 2007), as well as structural adaptations associated with strength development (Hughes et al., 2018).

Training load characteristics, including volume and intensity, are central determinants of strength progression (Kraemer, 2004; Schoenfeld et al., 2021).

In the present investigation, the longboard group demonstrated significantly higher 1RM values ($p=0.005$; $\eta^2=0.40$), suggesting a modality-dependent adaptation pattern. Similarly, average power differed significantly between groups ($p=0.001$; $\eta^2=0.52$).

Muscle power reflects the interaction between force production and contraction velocity (Cormie et al., 2011), and adaptations across the force-velocity continuum are influenced by the mechanical characteristics of task execution. The repeated propulsion cycles and deceleration phases typical of longboarding may also involve meaningful eccentric contributions, which are recognized as potent stimuli for strength and power development (Handford et al., 2022).

Conversely, street skateboarding is characterized by short-duration maneuvers interspersed with rest intervals (Diewald et al., 2024).

Although technically demanding, the cumulative mechanical workload may be lower than that observed in longboarding, potentially attenuating chronic neuromuscular adaptations. Previous exploratory work in skateboarding has reported variability in lower-limb force and power outputs depending on task demands (Candotti et al., 2012), reinforcing the relevance of modality-specific exposure.

Regarding asymmetry, no significant interlimb differences were observed within either group ($p>0.05$), and Asymmetry Index (%) values remained relatively low. These findings contrast with evidence from unilateral-dominant sports, where strength asymmetries have been associated with injury risk or performance outcomes (Junior et al., 2024; Kalata et al., 2020; Stella et al., 2022).

However, the recreational profile of the participants may explain the absence of pronounced imbalances. Lower training intensity and possible alternation of propulsion strategies may reduce chronic unilateral overload, thereby limiting asymmetry development.

It is important to acknowledge that asymmetry thresholds considered clinically meaningful remain debated in the literature (İnce, Tortu, 2024).

In the present study, asymmetry magnitudes did not approach levels typically associated with functional impairment or injury risk. Given that skateboarding injuries are common (Brudvik, 2006; Shuman, Meyers, 2015), understanding whether asymmetry contributes to injury mechanisms warrants further investigation.

The small sample size ($n=10$) limits statistical power and external validity. Although the use of MANOVA and effect size interpretation strengthens analytical robustness, replication with larger and more diverse samples is necessary.

Future studies should incorporate complementary assessments, such as functional performance tests or biomechanical analyses, to provide a more comprehensive characterization of neuromuscular adaptations.

In summary, longboarding appears to provide greater stimuli for maximal strength and average power development in the lower limbs compared to street skateboarding, without inducing detectable interlimb asymmetries in recreational practitioners. These findings

underscore the role of modality-specific mechanical demands in shaping neuromuscular performance and may inform evidence-based training prescription and injury-prevention strategies in skateboarding.

CONCLUSION

This preliminary study found no significant interlimb muscular asymmetries in recreational longboard and street skateboarders across isometric strength, maximal dynamic strength, and muscle power.

However, longboard practitioners demonstrated superior maximal dynamic strength and average power compared to street practitioners, indicating modality-specific neuromuscular demands.

These findings suggest that longboarding may provide a greater stimulus for lower-limb strength and power development without promoting detectable asymmetry, although confirmation in larger samples is required.

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