

Comparison of Physical Fitness and Isokinetic Muscle Function Between Wrestlers and Brazilian Jiu-Jitsu Athletes: A Cross-Sectional Study

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Abstract

Background

Wrestling and Brazilian Jiu-Jitsu (BJJ) are grappling-based combat sports that share several physical demands but differ substantially in their competitive and technical characteristics. Wrestling involves frequent high-intensity standing actions, including takedowns, lifts, and rapid transitions, whereas BJJ features prolonged ground-based exchanges, sustained gripping, and positional control. However, direct comparisons of multidimensional physical fitness and isokinetic muscle function between wrestlers and BJJ athletes remain limited. This study aimed to compare physical fitness, anaerobic and explosive performance, and lower-extremity and trunk isokinetic muscle function between wrestlers and BJJ athletes.

Method

This cross-sectional study included 38 male athletes (18 wrestlers and 20 BJJ athletes) with at least 6 years of training experience. Physical fitness assessments included handgrip strength, muscular endurance, flexibility, explosive performance, and maximal oxygen uptake ($\text{VO}_{2\text{max}}$). Lower-body anaerobic power was assessed using the 30-s Wingate Anaerobic Test. Isokinetic knee and trunk muscle function was assessed at different angular velocities. Between-group differences were examined using independent-samples t-tests, and effect sizes were calculated using Hedges' g with 95% confidence intervals.

Result

Wrestlers demonstrated greater push-up performance ($g = 1.43$), relative peak ($g = 1.07$), and mean ($g = 0.94$) Wingate power, explosive jump performance ($g = 0.69\text{--}0.71$), bilateral knee extensor power at $180^\circ/\text{s}$ ($g = 0.70\text{--}0.81$), and trunk extensor power at $120^\circ/\text{s}$ ($g = 1.00$) (all $p < 0.05$). BJJ athletes demonstrated greater right handgrip strength ($g = -0.66$), sit-up performance ($g = -0.70$), sit-and-reach ($g = -1.72$), trunk extension flexibility ($g = -1.03$), trunk flexor and extensor peak torque at $30^\circ/\text{s}$, and trunk flexor power at $120^\circ/\text{s}$ ($g = -0.93$) (all $p < 0.05$). $\text{VO}_{2\text{max}}$ and knee flexor and extensor peak torque at $60^\circ/\text{s}$ did not differ significantly between groups.

Conclusion

Wrestlers and BJJ athletes exhibited distinct physical fitness and isokinetic muscle function profiles. Wrestlers showed greater anaerobic and explosive performance and high-velocity knee and trunk extensor power, whereas BJJ athletes demonstrated greater flexibility and trunk flexor function. These

findings indicate that physical fitness assessment and conditioning in grappling athletes should account for the distinct functional demands of each sport.

Background

Wrestling is a grappling-based combat sport in which athletes attempt to control and defeat an opponent through grips, body contact, weight transfer, and positional control without striking. As one of the oldest competitive sports, wrestling has been contested under formalized rules since the ancient Olympic Games, and sports science has extensively investigated the physical and physiological characteristics of wrestlers [1]. Wrestling performance is characterized by takedowns, clinches, lifts, throws, and explosive extension movements initiated primarily from standing positions. These actions require wrestlers to rapidly disrupt an opponent's balance and repeatedly generate high levels of force over short periods. Accordingly, anaerobic power, maximal strength, muscular endurance, reaction time, and explosive strength are important determinants of wrestling performance [1–4]. In elite wrestlers, anaerobic power, muscular endurance, reaction time, wrestling-specific endurance, physical fitness, and technical performance are key factors associated with competitive performance [2]. Wrestling performance therefore depends on neuromuscular and metabolic capacities that support rapid force production and repeated high-intensity efforts.

Brazilian Jiu-Jitsu (BJJ), which originated from judo, has developed into a distinct combat sport characterized by ground fighting and submission techniques. The worldwide growth of BJJ participation and competition has increased interest in its physical and technical demands [5–7]. Simulated BJJ competition has also been shown to elicit substantial metabolic and cardiovascular responses across successive matches [8]. Most BJJ exchanges occur on the ground, where athletes must maintain postural control while performing guard retention, passes, sweeps, escapes, and submission techniques [6, 9]. In Gi competition, grips provide direct control over an opponent's posture and facilitate transitions between techniques, making handgrip strength and forearm muscular endurance particularly relevant to BJJ performance [5, 6, 9–12]. Guard positions and submission exchanges also require substantial mobility of the hips, spine, and pelvis together with sustained trunk activation. Flexibility, abdominal muscular endurance, and core function are therefore important physical attributes for technical performance in BJJ [5, 13, 14]. These demands differ from the predominantly standing explosive actions of wrestling, with BJJ placing greater demands on sustained grip control, trunk function, force production during ground contact, and mobility during positional transitions.

Wrestling and BJJ share fundamental characteristics as non-striking grappling sports. Both involve continuous physical contact, grip-based control, disruption of an opponent's balance, and the establishment of positional advantage. Grappling performance requires contributions from explosive strength, muscular endurance, anaerobic metabolism, aerobic recovery capacity, trunk muscle function, agility, and flexibility [1, 5, 15, 16]. High-intensity intermittent activity is common in wrestling, judo, and BJJ, while repeated pushing, pulling, and resisting an opponent impose substantial demands on upper- and lower-body strength and grip endurance [10, 17, 18]. These shared characteristics, however, do not

indicate equivalent physical demands because the competitive structure and technical requirements differ between disciplines. Physical fitness in wrestling and BJJ should therefore be examined according to the sport-specific demands imposed by their respective technical structures.

Evidence from other grappling disciplines supports the presence of sport-specific physical profiles. Coswig et al. [19] reported that the contributions of metabolic and neuromuscular fitness variables to performance differed between judo and BJJ athletes. Neuromuscular fitness variables accounted for a substantial proportion of performance-related variation in BJJ, supporting the relevance of strength, muscular endurance, power, and postural control during ground-based technical actions [19]. Differences have also been reported between judo and wrestling athletes in physical attributes including abdominal muscular endurance, upper-body resistance performance, and jumping ability [20]. These findings indicate that athletes may develop distinct physical profiles within grappling sports according to their competitive and technical demands. Although researchers have investigated strength, general physical fitness, and anaerobic power in wrestlers [3, 21–24], direct comparisons between wrestling and BJJ athletes across cardiorespiratory endurance, strength, muscular endurance, flexibility, explosive performance, lower-body anaerobic power, and lower-extremity and trunk isokinetic muscle function remain limited.

Sport-specific conditioning requires the prioritization of physical attributes according to the demands of competition [15]. In BJJ, conditioning programs should account for prolonged ground exchanges, sustained gripping, repeated positional transitions, and the temporal structure of competition [7, 14]. Wrestling places greater emphasis on high-intensity standing exchanges involving takedowns, clinches, lifting actions, and rapid transitions from defense to re-attack. Accordingly, lower-body explosive power and anaerobic power represent important components of wrestling-specific physical performance [1, 2, 25, 26]. Recent evidence further indicates a close relationship between lower-extremity isokinetic extensor strength and explosive jump performance in elite wrestlers [27]. Applying an identical conditioning approach to wrestlers and BJJ athletes may therefore fail to address the physical capacities most relevant to performance in each discipline. This study aimed to compare multidimensional physical fitness characteristics between wrestlers and BJJ athletes using the same assessment protocol.

Methods

Study design and participants

This cross-sectional comparative study was conducted and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [28] and included 38 male athletes: 18 wrestlers and 20 Brazilian Jiu-Jitsu (BJJ) athletes. Participants were eligible if they had trained in their respective sport for at least 6 years, trained at least four times per week, and placed within the top three at a national-level competition within the previous 6 months. Athletes were required to have no musculoskeletal injury, neurological disorder, cardiovascular disease,

or other condition that restricted maximal exercise testing or high-intensity physical fitness assessments.

Before participation, all athletes were informed of the study purpose, testing procedures, potential fatigue, and risks associated with the assessments. Only those who voluntarily agreed to participate were enrolled. Written informed consent was obtained from all participants before data collection. Age, height, body mass, body mass index (BMI), and training experience were recorded as participant characteristics. The study was approved by the Institutional Review Board of Chosun University (2-1041055-AB-N-01-2026-43).

All assessments were conducted under standardized laboratory conditions. Participants were instructed to avoid strenuous physical activity and alcohol and caffeine consumption on the day before testing. On the testing day, participants rested before completing anthropometric measurements, general physical fitness tests, cardiorespiratory fitness testing, anaerobic power testing, and isokinetic muscle function testing in sequence. Adequate recovery was provided between assessments to minimize the influence of fatigue. Cardiorespiratory fitness, anaerobic power, and isokinetic muscle function tests were initiated after heart rate and perceived fatigue had stabilized.

Measurements

Participants characteristics

Height and body mass were measured with participants wearing light clothing using a body composition analyzer (InBody 770, InBody, Republic of Korea). Height was measured to the nearest 0.1 cm with participants standing upright, and body mass was recorded to the nearest 0.1 kg. BMI was calculated as body mass divided by height squared (kg/m^2). The characteristics of the participants are presented in Table 1.

Table 1
Participants characteristics.

Variable	Wrestling athletes (n = 18) M ± SD	BJJ athletes (n = 20) M ± SD
Age (yr)	23.22 ± 1.40	23.10 ± 1.25
Height (cm)	180.10 ± 6.51	178.56 ± 4.49
Body mass (kg)	85.31 ± 8.84	85.76 ± 5.12
Training experience (yr)	6.67 ± 0.49	6.65 ± 0.49
Body fat (%)	10.54 ± 1.69	11.34 ± 1.48
BMI (kg/m^2)	26.25 ± 1.61	26.90 ± 1.32

BMI = body mass index.

Muscular strength

Muscular strength was assessed using handgrip strength measured with a handgrip dynamometer (TKK-401, Takei, Japan). Participants stood with their feet shoulder-width apart, kept their arms relaxed at their sides, and were instructed to squeeze the dynamometer with maximal effort. Elbow flexion and excessive trunk movement were restricted during each trial. The dominant and non-dominant hands were assessed separately. Two trials were performed for each hand, and the highest value was used for analysis. Handgrip strength was recorded in kilograms. Hand dominance was determined before testing, and all participants reported the right hand as dominant.

Muscular Endurance

Muscular endurance was assessed using push-up and sit-up tests. Push-up performance was measured using the FAS-5360 (Republic of Korea). Participants assumed a standardized push-up position and completed as many repetitions as possible within 60s. Trunk alignment, elbow range of motion, and the use of momentum were monitored throughout the test, and only repetitions performed with correct technique were recorded. Sit-up performance was measured using the FAS-5370 (Republic of Korea). Participants assumed a supine position with the knees flexed and the hands placed in the standardized position and completed as many repetitions as possible within 60 s. The examiner monitored the range of motion and use of momentum, and only correctly performed repetitions were recorded.

Flexibility

Flexibility was assessed using the sit-and-reach and trunk extension tests. The sit-and-reach test was performed using the TKK-403 (Takei, Japan). Participants sat with both feet against the footplate, with their knees fully extended, and slowly flexed the trunk forward without using momentum. The farthest position reached with both hands was recorded. Two trials were performed, and the highest value was used for analysis. Trunk extension flexibility was assessed using the TKK-5404 (Takei, Japan). Participants extended the trunk as far as possible from a standardized testing position while the lower extremities were stabilized. The achieved distance was recorded in centimeters. Two trials were performed, and the highest value was used for analysis.

Cardiorespiratory fitness

Cardiorespiratory fitness was assessed using a graded treadmill exercise test with respiratory gas analysis (QUARK CPET, COSMED, Italy). The KISS protocol developed by the Korea Institute of Sport Science was applied. Treadmill inclination was maintained at 6%, with an initial speed of 90 m/min. Speed was subsequently increased by 20 m/min every 2 min. Participants were instructed to continue exercising for as long as possible. Oxygen uptake, carbon dioxide production, and ventilation were continuously measured throughout the test. Maximal oxygen uptake ($\text{VO}_{2\text{max}}$) was determined as the

highest oxygen uptake recorded during the test and expressed as mL/kg/min. The test was terminated when the participant voluntarily indicated that exercise could no longer be continued.

Anaerobic power

Lower-body anaerobic power was assessed using the 30-s Wingate Anaerobic Test on a cycle ergometer (Monark 828E, Monark, Sweden). After a warm-up, the seat height and cycling position were individually adjusted. The resistance was set at 7.5% of body mass [29]. Participants began pedaling as rapidly as possible, after which the predetermined resistance was applied. They were instructed to maintain maximal effort for 30 s, with strong verbal encouragement provided throughout the test. Relative peak power (PP), relative mean power (MP), and fatigue index (FI) were analyzed. Peak power was defined as the highest power output achieved during the test, whereas mean power was calculated as the average power output over the 30-s test. Peak and mean power were normalized to body mass and expressed as W/kg. The fatigue index was calculated from the decrease between peak and minimum power output.

Explosive power

Explosive power was assessed using the standing long jump and Sargent jump tests. The standing long jump was measured using the FT-7700 (DAC, Republic of Korea). Participants stood behind the starting line with their feet shoulder-width apart and jumped forward as far as possible using a countermovement. They were instructed to maintain balance upon landing, and jump distance was measured from the starting line to the nearest point of heel contact. Two trials were performed, and the longest distance was used for analysis. The Sargent jump was measured using the T-150 (Seedtech, Republic of Korea). Participants began from an upright position and performed a maximal vertical jump. Arm use was standardized across participants, and jump height was recorded in centimeters. Two trials were performed, and the highest value was used for analysis.

Isokinetic muscle function

Isokinetic muscle function of the knee and trunk was assessed using an isokinetic dynamometer (Humac NORM, CSMi, USA). Before testing, participants performed familiarization trials to become accustomed to the testing position and movement. During the assessments, participants were instructed to perform each movement with maximal effort. Knee isokinetic muscle function was assessed during knee flexion and extension. Participants were seated with the pelvis, thigh, and trunk stabilized, and the rotational axis of the dynamometer was aligned with the anatomical axis of the knee joint. The range of motion was set from 0° of knee extension to 90° of knee flexion. Isokinetic strength was assessed over five repetitions at an angular velocity of 60°/s. Flexor and extensor peak torque relative to body weight (%BW) and the hamstring-to-quadriceps (H/Q) ratio were analyzed. Isokinetic muscle power was assessed over 15 repetitions at 180°/s, and flexor and extensor power relative to body weight were analyzed separately for both limbs [30]. Trunk isokinetic muscle function was assessed during trunk flexion and extension. Participants were stabilized in the testing apparatus to minimize compensatory movement of the pelvis and lower extremities, and the rotational axis of the

dynamometer was aligned with the axis of trunk movement. The range of motion was set from -10° to 70° . Isokinetic strength was assessed at $30^{\circ}/s$, with flexor and extensor peak torque normalized to body weight and the flexion-to-extension ratio included in the analysis. Isokinetic muscle power was assessed at $120^{\circ}/s$, and flexor and extensor power relative to body weight was analyzed.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 28.0 (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean $\pm$ standard deviation (SD). The normality of the data distribution was assessed using the Shapiro-Wilk test. As the variables satisfied the assumption of normality, differences in physical fitness and isokinetic muscle function between wrestlers and Brazilian Jiu-Jitsu (BJJ) athletes were examined using independent-samples t-tests. Effect sizes for between-group differences were calculated using Hedges' g , which provides a correction for small-sample bias, and are presented with 95% confidence intervals (CIs). Statistical significance was set at $p < 0.05$.

Result

Physical fitness outcomes are presented in Table 2. BJJ athletes demonstrated significantly greater right handgrip strength and sit-up performance than wrestlers, whereas wrestlers performed significantly more push-ups. BJJ athletes also showed greater flexibility in both the sit-and-reach and trunk extension tests. The largest between-group differences were observed for sit-and-reach (Hedges' $g = -1.72$, 95% CI $[-2.46, -0.98]$), push-ups ($g = 1.43$, 95% CI $[0.72, 2.13]$), and trunk extension ($g = -1.03$, 95% CI $[-1.70, -0.37]$). No significant differences were observed in average or left handgrip strength or VO_{2max} .

Table 2
Physical fitness characteristics of wrestlers and BJJ athletes

Variable	Wrestling athletes (n = 18) M ± SD	BJJ athletes (n = 20) M ± SD	t	p	Hedges' g (95% CI)
Average grip strength (kg)	44.52 ± 3.08	45.24 ± 2.81	-0.759	.453	-0.24 (-0.87, 0.39)
Right grip strength (kg)	43.99 ± 4.40	47.06 ± 4.71	-2.074	.045*	-0.66 (-1.30, 0.02)
Left grip strength (kg)	45.03 ± 4.77	43.42 ± 4.34	1.092	.282	0.35 (-0.28, 0.98)
Sit-ups (reps)	44.94 ± 4.57	48.55 ± 5.44	-2.198	.034*	-0.70 (-1.34, -0.06)
Push-ups (reps)	52.39 ± 5.60	45.30 ± 4.09	4.489	< .001***	1.43 (0.72, 2.13)
Sit-and-reach (cm)	11.23 ± 1.94	14.31 ± 1.57	-5.399	< .001***	-1.72 (-2.46, -0.98)
Trunk extension (cm)	57.62 ± 4.69	62.55 ± 4.64	-3.26	.002**	-1.03 (-1.70, -0.37)
VO ₂ max (mL/kg/min)	63.07 ± 6.94	59.74 ± 6.57	1.518	.138	0.48 (-0.15, 1.12)
* p < 0.05, ** p < 0.01, *** p < 0.001					

Anaerobic and explosive performance outcomes are presented in Table 3. Wrestlers demonstrated significantly higher relative peak and mean power during the Wingate test, with Hedges' g values of 1.07 (95% CI [0.40, 1.74]) and 0.94 (95% CI [0.28, 1.60]), respectively. The fatigue index was also significantly higher in wrestlers. Wrestlers achieved significantly greater performance in both the Sargent jump and standing long jump.

Table 3
Anaerobic and explosive performance of wrestlers and BJJ athletes

Variable	Wrestling athletes (n = 18) M ± SD	BJJ athletes (n = 20) M ± SD	t	p	Hedges' g (95% CI)
Peak power, PP (W/kg)	13.48 ± 0.66	12.34 ± 1.30	3.339	.002**	1.07 (0.40, 1.74)
Mean power, MP (W/kg)	6.39 ± 0.55	5.79 ± 0.68	2.9	.006**	0.94 (0.28, 1.60)
Fatigue index, FI (%)	62.39 ± 6.86	57.89 ± 6.37	2.094	.043*	0.67 (0.02, 1.31)
Sargent jump (cm)	42.44 ± 4.58	39.58 ± 3.26	2.229	.032*	0.71 (0.07, 1.36)
Standing long jump (cm)	222.52 ± 24.48	206.19 ± 22.18	2.158	.038*	0.69 (0.04, 1.33)
* p < 0.05, ** p < 0.01					

Isokinetic knee and trunk muscle function outcomes are presented in Table 4. No significant between-group differences were observed in knee flexor or extensor peak torque or H/Q ratios at 60°/s. At 180°/s, wrestlers demonstrated significantly greater bilateral knee extensor power, whereas flexor power did not differ significantly between groups. For trunk muscle function at 30°/s, BJJ athletes demonstrated significantly higher flexion-to-extension ratios and relative flexor and extensor peak torque. The largest difference was observed for relative flexor peak torque (Hedges' g = -1.08, 95% CI [-1.75, -0.41]). At 120°/s, flexor power was significantly higher in BJJ athletes (g = -0.93, 95% CI [-1.59, -0.27]), whereas extensor power was significantly higher in wrestlers (g = 1.00, 95% CI [0.33, 1.66]).

Table 4
Physical fitness characteristics of wrestlers and BJJ athletes

Variable	Wrestling athletes (n = 18) M ± SD	BJJ athletes (n = 20) M ± SD	t	p	Hedges' g (95% CI)
Knee isokinetic muscle function (60°/s)					
Right flexor (%BW)	116.32 ± 13.50	109.09 ± 17.12	1.434	.160	0.46 (-0.18, 1.09)
Right extensor (%BW)	208.54 ± 22.94	204.53 ± 21.94	0.549	.586	0.18 (-0.45, 0.80)
Right H/Q ratio (%)	53.71 ± 3.72	53.35 ± 3.73	0.299	.766	0.09 (-0.53, 0.72)
Left flexor (%BW)	107.02 ± 11.02	104.88 ± 10.66	0.608	.547	0.19 (-0.43, 0.82)
Left extensor (%BW)	202.61 ± 23.81	199.41 ± 23.27	0.418	.678	0.13 (-0.49, 0.76)
Left H/Q ratio (%)	51.30 ± 4.49	50.86 ± 3.71	0.332	.741	0.11 (-0.52, 0.73)
Knee isokinetic muscle power (180°/s)					
Right extensor power (%BW)	257.408 ± 21.407	239.617 ± 27.430	2.21	.033*	0.70 (0.06, 1.35)
Left extensor power (%BW)	251.372 ± 19.025	234.286 ± 21.870	2.56	.015*	0.81 (0.16, 1.46)
Right flexor power (%BW)	164.815 ± 17.189	158.743 ± 20.720	0.98	.335	0.31 (-0.32, 0.94)
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$					

Variable	Wrestling athletes (n = 18) M ± SD	BJJ athletes (n = 20) M ± SD	t	p	Hedges' g (95% CI)
Left flexor power (%BW)	160.073 ± 16.897	154.392 ± 23.760	0.84	.406	0.27 (-0.36, 0.89)
Trunk isokinetic muscle function (30°/s)					
Flexion/extension ratio (%)	177.33 ± 19.51	190.79 ± 20.99	-2.041	.049*	-0.65 (-1.29, -0.01)
Flexor/BW ratio (%BW)	432.91 ± 22.94	459.18 ± 24.47	-3.403	.002**	-1.08 (-1.75, -0.41)
Extensor/BW ratio (%BW)	255.53 ± 17.36	272.48 ± 29.90	-2.162	.038*	-0.67 (-1.31, -0.03)
Trunk isokinetic muscle power (120°/s)					
Flexor power (%BW)	280.06 ± 22.65	300.43 ± 20.09	-2.939	.006**	-0.93 (-1.59, -0.27)
Extensor power (%BW)	212.98 ± 23.43	190.37 ± 20.94	3.141	.003**	1.00 (0.33, 1.66)
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$					

Discussion

This study compared multidimensional physical fitness profiles between wrestlers and BJJ athletes under standardized testing conditions. Wrestlers demonstrated greater upper-body muscular endurance, anaerobic power, explosive performance, knee extensor power, and trunk extensor power, whereas BJJ athletes showed greater flexibility, sit-up performance, right handgrip strength, and trunk flexor function. In contrast, VO_2 max and knee flexor and extensor strength at 60°/s did not differ significantly between groups. These findings support the hypothesis that wrestlers and BJJ athletes exhibit distinct physical fitness profiles despite both participating in grappling-based combat sports.

BJJ athletes demonstrated greater right handgrip strength and sit-up performance, whereas wrestlers showed substantially greater push-up performance. Grip strength is particularly relevant to BJJ because sustained gripping is repeatedly required to control an opponent's posture and establish or maintain technical positions, especially in Gi-based competition [5, 6, 9–12]. Recent evidence further suggests that strength characteristics in BJJ athletes may vary according to training experience, Gi preference, and fighting style [31]. The greater right handgrip strength observed in the BJJ group may therefore reflect these sport-specific gripping demands. However, because the difference was limited to the right hand, with no between-group differences in average or left handgrip strength, this finding should not be interpreted as evidence of generally greater maximal grip strength in BJJ athletes. Bilateral differences may also be related to grip-specific force production and asymmetry in grappling athletes [32]. In contrast, the markedly greater push-up performance in wrestlers (Hedges' $g = 1.43$) is consistent with the repeated upper-body pushing and bracing demands involved in maintaining contact, resisting an opponent, and rapidly transitioning between offensive and defensive actions in wrestling [1]. The greater sit-up performance in BJJ athletes may similarly reflect the sustained trunk involvement required during guard maintenance, positional transitions, and ground-based exchanges [5, 12, 13].

BJJ athletes demonstrated greater flexibility in both the sit-and-reach and trunk extension tests, with particularly pronounced between-group differences in sit-and-reach (Hedges' $g = -1.72$) and trunk extension ($g = -1.03$). These findings are consistent with previous reports identifying flexibility as an important component of the physical profile of BJJ athletes [11, 33, 34]. In contrast to flexibility, VO_{2max} did not differ significantly between groups. Both wrestling and BJJ involve repeated high-intensity efforts interspersed with lower-intensity activity, and aerobic capacity contributes to sustaining performance and recovery across these intermittent demands [14, 18, 20, 35].

Wrestlers demonstrated consistently greater anaerobic and explosive performance than BJJ athletes, including higher relative peak and mean power during the Wingate test and greater Sargent jump and standing long jump performance. The between-group differences were particularly evident for relative peak power (Hedges' $g = 1.07$) and mean power ($g = 0.94$). This profile closely matches the physical demands of wrestling, where takedowns, lifts, and rapid offensive-defensive transitions require substantial force and power over short periods. Anaerobic power has consistently been identified as an important determinant of wrestling performance [1–3, 19, 20], supporting the greater power outputs observed in the wrestlers in the present study. Previous research has also reported greater muscle power and jumping performance in higher-level wrestlers, supporting the relevance of explosive lower-body performance to wrestling [3]. In contrast, BJJ competition is characterized by prolonged ground-based exchanges in which positional control and technical efficiency play substantial roles alongside intermittent high-intensity actions [6, 11]. Sport-specific performance in BJJ has also been examined in relation to anaerobic and neuromuscular capacities, including Wingate performance, vertical jump performance, and isokinetic hip flexor function [36, 37]. The higher fatigue index observed in wrestlers should be interpreted alongside their greater peak and mean power rather than as superior fatigue resistance. It indicates a greater decline in power output during the 30-s Wingate test, which may reflect the higher initial power output achieved by the wrestling group.

Knee isokinetic function showed a velocity- and contraction-specific pattern. At 60°/s, no significant between-group differences were observed in flexor or extensor peak torque or H/Q ratios. In contrast, at 180°/s, wrestlers demonstrated greater extensor power in both limbs, with Hedges' g values of 0.70 for the right and 0.81 for the left limb, whereas flexor power did not differ between groups. Previous research in elite wrestlers has assessed knee flexor and extensor function across multiple angular velocities, including 60°/s and 180°/s, supporting the relevance of velocity-specific assessment of knee muscle function in this population [38, 39]. The absence of between-group differences at 60°/s, together with greater bilateral extensor power in wrestlers at 180°/s, suggests that between-sport differences in knee muscle function may become more apparent under higher-velocity conditions. Previous isokinetic studies in wrestlers have similarly evaluated knee function across multiple angular velocities, indicating that the interpretation of knee strength characteristics should consider testing velocity [38, 40]. BJJ, in contrast, involves fewer explosive lower-limb extension actions from the standing position, with more competition occurring during ground-based positional control and submission exchanges [6, 11]. The absence of a between-group difference in flexor power further suggests that the distinction in high-velocity knee function was specific to the extensors rather than reflecting a generalized difference in lower-limb power.

Trunk isokinetic function showed a distinct pattern according to angular velocity and movement direction. At 30°/s, BJJ athletes demonstrated greater relative flexor and extensor peak torque and a higher flexion-to-extension ratio than wrestlers, with the largest between-group difference observed for relative flexor peak torque (Hedges' g = -1.08). At 120°/s, BJJ athletes demonstrated greater flexor power (g = -0.93), whereas wrestlers demonstrated greater extensor power (g = 1.00). The greater trunk flexor function observed in BJJ athletes may be related to the substantial trunk involvement required during guard maintenance, sweeps, escapes, and other ground-based positional exchanges [5, 6, 11]. Previous studies have demonstrated distinct trunk muscle characteristics in wrestlers, including isokinetic flexor and extensor function assessed across different angular velocities [41–43]. High-velocity trunk power may be relevant to the rapid trunk actions required during wrestling [41, 42]. The opposing pattern observed at 120°/s greater flexor power in BJJ athletes but greater extensor power in wrestlers therefore provides further evidence that trunk muscle function differs between these groups not simply in magnitude, but according to the direction and velocity of force production.

This study has several limitations. First, the relatively small sample size, comprising 18 wrestlers and 20 BJJ athletes, may limit the generalizability of the findings to broader populations of wrestlers and BJJ athletes. Second, the cross-sectional design does not allow determination of whether the observed differences resulted from sport-specific training adaptations or other athlete characteristics. Therefore, the findings should be interpreted as differences in physical fitness profiles between the two groups rather than as effects of participation in either sport. Third, physical fitness and isokinetic muscle function were assessed under standardized laboratory conditions without concurrent analysis of actual competition performance or technical and tactical characteristics. Consequently, the extent to which the observed differences are associated with sport-specific competitive performance remains unclear.

Future studies with larger samples and longitudinal designs should examine changes in these physical characteristics alongside sport-specific performance measures.

Conclusion

This study identified distinct physical fitness profiles in wrestlers and BJJ athletes. Wrestlers demonstrated greater push-up performance, anaerobic and explosive power, high-velocity knee extensor power, and trunk extensor power, whereas BJJ athletes showed greater flexibility, sit-up performance, right handgrip strength, and trunk flexor function. Notably, differences in isokinetic muscle function depended on both angular velocity and movement direction, while $VO_2\text{max}$ and knee flexor and extensor strength at $60^\circ/\text{s}$ were comparable between groups. These findings indicate that wrestlers and BJJ athletes should not be characterized by a single physical fitness profile despite both participating in grappling-based combat sports. Sport-specific physical fitness assessment and conditioning should therefore reflect each sport's distinct functional demands, with particular attention to explosive, high-velocity extension performance in wrestling and flexibility, trunk function, and sport-specific gripping demands in BJJ.

Abbreviations

BJJ	
Brazilian Jiu-Jitsu	
BMI	
Body mass index	
BW	
Body weight	
FI	
Fatigue index	
H/Q	
Hamstring-to-quadriceps ratio	
MP	
Mean power	
PP	
Peak power	
$VO_2\text{max}$	
Maximal oxygen uptake	

Declarations

Ethics approval and consent to participate

The study was approved by the Institutional Review Board of Chosun University (2-1041055-AB-N-01-2026-43). All participants were informed of the purpose and procedures of the study, and written informed consent was obtained from all participants before participation.

Consent for publication

Not applicable.

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Author Contribution

DH led the study design, and DH and SE conducted all literature searches and analyzed all data. SE reviewed the analysis of the literature. DH drafted the initial manuscript, and SE reviewed the manuscript.

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Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

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