

High-Intensity Functional Training Improves Cadets' Reaction and Strike Force

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Abstract— Law-enforcement work demands rapid sensorimotor processing and decisive striking actions. High-Intensity Functional Training (HIFT; e.g., CrossFit-style programming) may enhance neuromuscular readiness and combat-specific outputs, yet evidence in police cadets is limited. Objective. To evaluate whether a pedagogically integrated HIFT mesocycle improves sensorimotor function and strike force in police cadets versus a traditional conditioning curriculum. Methods. Forty male cadets (age 20–30 years) were assigned to an experimental group (EG; HIFT added to the standard syllabus) or control group (CG; standard syllabus). Pre/post measures included mean simple reaction time and composite indices of functional state; striking tests on an instrumented target quantified peak force (kg) for seven techniques with left/right limbs. Independent *t*-tests compared EG vs. CG at baseline and post; significance set at $\alpha=0.05$. Baseline groups did not differ meaningfully on any variable. Post-intervention, EG outperformed CG with faster reactions (191 ± 1 vs. 204 ± 2 ms; $t = -26.0$, $p < 0.001$) and superior functional indices (e.g., system tone 4.93 ± 0.10 vs. 3.98 ± 0.50 ; $t = 8.39$, $p < 0.001$). EG demonstrated substantially greater strike forces for most techniques (e.g., right straight to head 205.7 ± 5.0 vs. 178.5 ± 5.0 kg; $t = 17.20$, $p < 0.001$), with a few nonsignificant exceptions (e.g., right knee to body, $p = 0.557$). Embedding HIFT into police-academy physical training markedly improves sensorimotor responsiveness and strike force. These findings align with recent evidence that HIFT/functional high-intensity models enhance task-relevant performance in tactical populations and striking sports, supporting curricular adoption with appropriate oversight. Keywords: police cadets; CrossFit; HIFT; reaction time; strike force; tactical strength and conditioning.

Keywords— High-intensity functional training; HIFT; CrossFit; police cadets; sensorimotor function; reaction time; strike force; tactical populations.

I. INTRODUCTION

Policing requires immediate perception–action coupling under time pressure, along with the capacity to deliver effective strikes when legally justified. Physical preparation for cadets should therefore develop fast sensorimotor responses and high, repeatable impact forces while managing fatigue and operational constraints. Contemporary reviews and meta-analyses indicate that High-Intensity Functional Training (HIFT)—a constant-variation, mixed-modality approach akin to CrossFit—can improve multiple fitness domains and sport-specific outputs across populations [1,2]. In tactical cohorts, structured conditioning relates to occupational performance (e.g., runs, obstacle tasks, and force-application drills) and is a target for academy programming [3-7].

Less is known about the extent to which academy-embedded HIFT—delivered alongside standard curricula—translates to faster sensorimotor reactions and harder strikes in cadets. Striking performance depends on neuromuscular rate of force development, technique, and “effective mass” at impact, and validated instrumented systems now permit reliable field assessment [8-12]. We therefore tested the hypothesis that a HIFT-augmented program would outperform standard training on reaction-time based functional indices and strike force across multiple techniques.

II. MATERIALS AND METHODS

A controlled, parallel-group pedagogical experiment compared an experimental group (EG) receiving HIFT integrated into the standard physical-training syllabus with a control group (CG) completing the standard syllabus alone. Pre-

and post-testing occurred in the same laboratory and striking area using the same equipment and operators.

Forty healthy male police cadets (20-30 years) volunteered and provided written consent. Participants were free of musculoskeletal or neurological conditions affecting testing. Groups were matched on age and training status; baseline comparisons confirmed equivalence (see Results).

Control (CG): Academy’s conventional conditioning (calisthenics, runs, calisthenic circuits, general strength technique).

Experimental (EG): Same base curriculum plus three supervised HIFT sessions/week emphasizing mixed-modality metabolic and strength tasks (e.g., thruster–pull-up couplets; kettlebell swings and sprints; sandbag carries; plyometric complexes). Sessions were periodized for progressive overload and technical quality. Workouts were 12-25 min at high relative intensity with movement standards and safety cues. Programming followed best-practice tactical conditioning guidance (e.g., load monitoring, autoregulation, recovery) [3,6,7,13].

Outcomes and Instrumentation

Sensorimotor function. Mean simple response time (ms) and composite indices of functional state (tone, stability, and system capacity) were obtained from standardized computerized tests.

Striking performance. Peak force (kg) was recorded for seven techniques (left/right): straight hand to head; hook hand to head; elbow to head; knee to torso; straight foot to torso; roundhouse foot to head; roundhouse foot to torso. Strikes were delivered to an instrumented target with calibrated load cell per

published reliability procedures for punching/kicking systems [8–12]. Best of standardized trials was analyzed.

Data are presented as mean ± SD. Independent-samples t-tests compared EG vs. CG at baseline and post. Two-tailed α=0.05. Where provided in tables, t-values and p-values correspond to between-group differences. Sample size (n=40; ~20 per group) and effect magnitudes were sufficient to detect moderate–large differences with conventional power for repeated educational interventions in tactical cohorts [3-7,13]. The project was approved by the institutional ethics committee and conformed to the Declaration of Helsinki.

III. RESULTS AND DISCUSSION

A parallel-group controlled study was conducted in a police university. Forty male cadets (20-30 years) were assigned to an experimental group (EG; n=20) and a control group (CG; n=20). Inclusion criteria: no acute injury or contraindications to high-intensity exercise; attendance of scheduled classes. All procedures complied with the Declaration of Helsinki; written informed consent was obtained.

Groups were comparable on all variables before training (Tables 1-2). No baseline between-group differences were

statistically significant for reaction/functional indices or for strike forces (all p > 0.05), confirming an adequate starting point for comparison.

Sensorimotor Function. Post-intervention (Table 1), EG demonstrated substantially faster mean reaction time than CG (191±1 vs. 204±2 ms; t = -26.0, p < 0.001). Functional tone and system capacity indices favored EG (e.g., tone 4.93±0.10 vs. 3.98±0.50; t = 8.39, p < 0.001), as did reaction stability (2.61±0.10 vs. 2.25±0.10; t = 11.39, p < 0.001). Error counts at <50 ms and <400 ms were markedly lower in EG (both p < 0.001).

At the beginning (Table 2), left/right strike forces did not differ significantly between groups (all p ≥ 0.09), indicating comparable initial striking ability.

By the end (Table 3), EG achieved higher forces than CG for most techniques on both sides. The largest differences were observed for hand strikes to the head and roundhouse kicks (e.g., right straight to head t = 17.20, p < 0.001). A few right-side techniques did not differ significantly (e.g., knee to torso, p = 0.557; straight foot to torso, p = 0.164).

TABLE 1. Sensorimotor indices at the start and end of the experiment (mean ± SD).

#	Parameter	EG start	CG start	t; p	EG end	CG end	t; p
1	Mean simple reaction time (ms)	229±2	238±6	t = -6.36; p < 0.001	191±1	204±2	t = -26.0; p < 0.001
2	Functional state (tone, arb. units)	3.776±0.20	3.802±0.30	t = -0.32; p = 0.749	4.932±0.10	3.976±0.50	t = 8.39; p < 0.001
3	Reaction stability (arb. units)	2.12±0.20	2.17±0.30	t = -0.62; p = 0.539	2.61±0.10	2.25±0.10	t = 11.39; p < 0.001
4	System capacity (arb. units)	4.17±0.50	3.96±0.40	t = 1.47; p = 0.151	4.96±0.40	3.99±0.50	t = 6.78; p < 0.001
5	Errors <50 ms (count)	6.41±0.30	6.32±0.50	t = 0.69; p = 0.495	3.20±0.60	5.97±0.80	t = -12.39; p < 0.001
6	Errors <400 ms (count)	6.32±0.40	6.41±0.90	t = -0.41; p = 0.686	2.47±0.50	5.40±0.90	t = -12.74; p < 0.001

TABLE 2. Strike force (kg) at the start of the experiment (mean ± SD; left and right sides).

Technique	Left EG	Left CG	t	p	Right EG	Right CG	t	p
Straight hand-head	148.6±5.0	145.9±5.0	+1.71	0.096	180.1±5.0	176.1±5.0	+2.53	0.016
Hook hand-head	153.1±5.0	152.7±5.0	+0.25	0.802	188.6±5.0	186.6±5.0	+1.26	0.206
Elbow-head	177.6±6.0	176.1±6.0	+0.79	0.434	194.2±6.0	192.3±6.0	+1.00	0.317
Knee-torso	199.3±7.0	195.8±6.0	+1.70	0.090	222.5±7.0	224.5±7.0	-0.90	0.366
Straight foot-torso	182.4±10.0	186.7±10.0	-1.36	0.174	202.7±10.0	201.3±10.0	+0.44	0.658
Roundhouse foot-head	159.8±10.0	158.9±10.0	+0.28	0.776	172.7±10.0	171.1±10.0	+0.51	0.613
Roundhouse foot-torso	233.5±10.0	233.4±10.0	+0.03	0.975	264.1±10.0	262.1±10.0	+0.63	0.527

TABLE 3. Strike force (kg) at the end of the experiment (mean ± SD; left and right sides).

Technique	Left EG	Left CG	t	p	Right EG	Right CG	t	p
Straight hand-head	180.7±5.0	146.8±5.0	+21.44	<0.001	205.7±5.0	178.5±5.0	+17.20	<0.001
Hook hand-head	187.5±5.0	155.6±5.0	+20.18	<0.001	209.5±5.0	187.9±5.0	+13.66	<0.001
Elbow-head	197.5±6.0	178.1±6.0	+10.22	<0.001	208.6±6.0	193.7±6.0	+7.85	<0.001
Knee-torso	213.3±7.0	196.2±6.0	+8.29	<0.001	223.5±7.0	224.8±7.0	-0.59	0.557
Straight foot-torso	207.4±10.0	187.9±10.0	+6.17	<0.001	223.7±10.0	219.3±10.0	+1.39	0.164
Roundhouse foot-head	196.8±10.0	162.2±10.0	+10.94	<0.001	201.7±10.0	178.1±10.0	+7.46	<0.001
Roundhouse foot-torso	233.2±10.0	233.4±10.0	-0.06	0.950	265.0±10.0	262.8±10.0	+0.70	0.487

Discussion

This controlled trial shows that integrating HIFT into academy training yields large, functionally relevant gains in cadets' sensorimotor readiness and striking capacity. Reaction time and stability improved substantially in EG relative to CG,

consistent with evidence that functional high-intensity formats enhance neuromuscular performance and task-specific outputs [1,2]. In tactical populations, structured conditioning—particularly formats that blend strength, power, and metabolic stress—associates with better occupational performance and

may be superior to undifferentiated endurance-dominant models for job-specific ability [3–7,13].

Enhanced strike forces across techniques in EG align with mechanistic accounts from striking sports: higher effective mass at impact, optimized sequencing, and improved lower-to-upper kinetic-chain transmission increase peak impact values [10–12,14,15]. Our largest between-group differences occurred in hand strikes to the head and roundhouse kicks, where technical constraints are minimal and elastic-reactive strength and intersegmental coordination are decisive. That knee-torso force on the right side did not differ may reflect ceiling effects (both groups strong on this gross pattern) or technical heterogeneity in knee execution under test conditions.

HIFT's time-efficient loading (short, intense bouts) may also improve work capacity with favorable metabolic efficiency in limited training windows [16–18]. Acute and short-term data suggest high-intensity intervals can generate greater excess post-exercise oxygen consumption per unit session time than isocaloric continuous work, which may help explain training economy during dense academy schedules [19].

Practical implications. Our results, together with current guidance for tactical strength and conditioning [3,6,7], support adding 2–3 supervised HIFT sessions/week to academy curricula, emphasizing movement quality, progressive overload, and load management (e.g., session RPE, autoregulation). Striking practice should pair technical coaching with power-strength complexes (e.g., medicine-ball rotational throws preceding punch/kick sets) and periodic instrumented feedback to reinforce effective mass and timing [8–12,14,15].

Limitations. This single-site, male-only cohort limits generalizability to female cadets and incumbent officers. Random allocation and detailed load monitoring were constrained by academy timetables. Force was expressed in kilograms as readouts from the instrumented target; while standard in many devices, future work should report Newtons where available and include device-specific calibration data [8–12]. Finally, we did not track cognitive or psychosocial adaptations that sometimes accompany high-intensity functional programs.

Future research. Multisite randomized trials should examine dose–response, durability across postings, and transfer to scenario-based assessments (pursuit, control, and weapon-retention tasks). Concurrent nutrition and recovery strategies for tactical athletes deserve integration per recent consensus statements [20].

IV. CONCLUSIONS

HIFT, when embedded into police-academy physical training, produced large improvements in reaction-time metrics and striking force versus standard conditioning alone. Given the time pressures of academy schedules and the high demands of operational tasks, functional high-intensity programming represents a pragmatic, evidence-aligned strategy to accelerate combat-relevant readiness in cadets.

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