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The Effectiveness of Tactical Actions on the Offensive System of Male Elite Judo Athletes in Olympic Tournaments

By Amar Ait Ali Yahia

Abstract: *A judo fight is an intellectual space because of the tactics involved in its management. As a fundamental factor, these tactics contribute effectively to performance. This study aimed to calculate, compare and analyse the most frequent and effective tactical actions chosen by male elite athletes. A sample of 112 Olympic medallists, comprising 28 gold, 28 silver and 56 bronze medals, accomplished 3,991 tactical actions in 575 fights at four successive Olympic Games (2004-2016). The Kolmogorov-Smirnov test assessed the normality of the collected data. The Levene's test showed the equality of variance. ANOVA (one factor) made inter-Olympic (longitudinal study) and intra-Olympic (cross-sectional study) comparisons, followed by the Post hoc Bonferroni test ($p < 0.05$). Eta squared η^2 and d of Cohen estimated the effect size. Olympic medallists performed respectively $74.8 \pm 6.9\%$ direct attacks, $9.3 \pm 3.8\%$ combination, $7.8 \pm 3.3\%$ standing to ground transition, and $5.6 \pm 3.4\%$ counterattack. In terms of effectiveness, direct attack $54.1 \pm 13.3\%$ dominates ahead of counterattack $15.3 \pm 10.1\%$, combination $14.6 \pm 7.5\%$, and standing to ground transition $13.6 \pm 8.9\%$. Feint and repeated attacks had a negligible contribution. The offensive system of Olympic medallists is mostly based on direct attacks, but additional options such as counterattack, combination and standing to ground transition also led to their success. The findings of this study could help improve the tactical preparation of elite judo athletes.*

Keywords: *combats sports; judoka; tactics analysis; high-level; competition*

Judo performance is complex, unpredictable and multifactorial. A literature review highlights many theoretical models based on individual and environmental factors that assist coaches in planning their *judoka's* success (Maekawa et al., 2013; Ferreira Celestino et al., 2015; Uriarte Marcos et al., 2019; Mazzei et al., 2020; Brito et al., 2020). These models consider tactics as one of the principal factors contributing effectively to judo achievement. From a general perspective, tactics are the art of fixing means to achieve immediate or short-term objectives (Black & Black, 2006). Concerning judo, tactics are the art and science of fighting, involving variables such as grips, displacements, defence, velocity, and executing technical movements (Sacripanti, 2015). Tactics are also intellectual tools to conduct bouts, allowing a rational technical choice by considering both the opponent and external conditions. They are various offensive and defensive plans that overcome an opponent while following the refereeing rules. Lee (1994) identified a tactical plan as a reflection elaborated by the coach for his elite athlete, considering distinct hypotheses to enable him to participate assuredly and securely in a competition by imagining its progress. Managing a tournament, leading a fight and making up an attack are the primary objectives of tactical preparation (Plotnikov, 2010). In

addition, judo competition requires different tactics. The elite athlete adopts energy tactics to impose their physical approach when choosing various intensities of confrontation. They use psychological tactics to neutralise, frustrate and prevent the opponent from expressing himself offensively while disturbing his means, serenity and attention. To counterbalance the opponent's technical project, the elite athlete chooses the technical tactics by considering his displacements, *kumi-kata*, the direction of unbalance, and body position (Rosso et al., 2006).

Judo competition is an uncertain environment demanding a specific tactical mastery to execute technical action. Opponents strengthen their defence to avoid being thrown or immobilised, making victory challenging. For this reason, competition management requires a developed tactical sense, an attribute of outstanding elite athletes. Tactical knowledge creates favourable conditions to express *tokui-waza* (preferred technique). Despite some weaknesses, elite athletes exploit every opportunity to impose their strengths, leading to exceptional performances. Indeed, tactical versatility contributed to Waldemar Legien's 1988 and 1992 Olympic titles (Boguszewski, 2006; Adam et al., 2014). Effective attacks and strong defence allowed Teddy Riner to win 2012 and 2016 gold medals



(Adam & Volska, 2016). Considering his exploits, experts cite Tadahiro Nomura as the greatest *judoka*. His tactical mastery enabled him to win three Olympic gold medals in a row (Atlanta 1996, Sydney 2000, and Athens 2004), becoming the only *judoka* to achieve such a performance in judo history (Olympics.com, 2021). Despite his distinguished achievements, the scientific community continues to ignore this living legend as a research subject. His longevity is exceptional since he retired 19 years after his first Olympic title, at age 40 (Rouquette, 2015).

To succeed in sport, the elite athlete must adapt their tactical choices to their opponent, rationally distribute their efforts and conceal their technical and tactical intentions (Manno, 1992). Tactical thinking is expressed through tactical knowledge, experience and the ability to make rapid and effective decisions (Kriventsova et al., 2017). To improve it, Zadorozhna et al. (2020) recommend some tasks such as adopting an effective strategy, building up the most effective tactical options, training how to make the right decision during the fight and learning how to anticipate the opponent's actions. In contrast, tactical knowledge may allow athletes to understand tactics, acquire a repertoire of tactical patterns and apply them based on different situations and opponents (Zadorozhna et al., 2021). Further, tactical versatility is the ability to master various tactical actions for solving defensive problems and be tactically unpredictable. A long-term tactical syllabus is required to develop it. As tactical learning topics, the French Judo Federation has proposed direct attack, combination, feint, repeated attack, counterattack, and ground to standing transition (FJFAD, 1989).

their tactical options in defence and attack. A rigorous examination of the principal tactical trends contributes to the rational development of judo training. Several authors analysing the Olympic Games and world championships have failed to study tactics variables profoundly (Moya & Tartbull, 2003; Heinisch & Busch, 2011; Heinisch et al., 2013; Ito et al., 2014; Ait Ali Yahia, 2014, 2015; Boguszewski, 2016; Mayo et al., 2019; Nagai et al., 2019). Hence, modelling elite judo tendencies is possible by evaluating several Olympic Games. This study aims to calculate, compare and analyse the most frequent and effective tactical actions implemented by Olympic male medallists. Thus, considering the judo refereeing changes in recent years (IJF, 2010, 2013), we hypothesised that a tactical tendency specific to each Olympic Games emerged through the offensive approach of Olympic medallists.

METHODS AND MATERIAL

Participants

The present research analysed 112 male medallists comprising 28 gold, 28 silver and 56 bronze medals in all seven weight categories from the 2004 to 2016 Olympic tournaments. The video recordings of 575 fights (138 gold, 141 silver, and 296 bronze) formed the research material. To throw their opponents, medallists performed 3,991 tactical actions: 956 gold, 1060 silver, and 1975 bronze (Table 1). The analysis investigated eliminatory fights, quarter-finals, semi-finals, finals, repechage and third place.

Measures

The current research analysed tactical actions defined by

Table 1. Data of Olympic medallists

	Medallists			Fights			Tactical actions		
	Gold	Silver	Bronze	Gold	Silver	Bronze	Gold	Silver	Bronze
Athens	7	7	14	35	35	81	239	276	558
Beijing	7	7	14	34	35	74	232	319	542
London	7	7	14	35	36	71	239	240	510
Rio	7	7	14	34	35	70	246	225	365

Physical, technical and psychological aspects are determinant factors in sports performance. However, most judo researchers have focused on these factors, underestimating the contribution of tactics. Analysing judo's success from a tactical standpoint could challenge this opinion and address several unanswered practical issues. Also, this study could investigate how elite judo athletes configure

the French Judo Federation and Associated Disciplines (FJFAD, 1989). Tactical knowledge of judo includes several ways to beat the opponent. A direct attack is any attempt to throw the opponent with a single attack. When this first attack fails because the defender blocks it, *Tori* (the attacker) can attempt a second attack; this is a combination. Faced with strict defence, the attacker can try to

feint, simulating an action in one direction to trick the opponent into performing the first planned technique. If the throw is ineffective and the opponent releases his guard, the attacker may repeat the same action several times, adapting to the opponent's new positions. It is called a repeat attack. Standing to ground transition marks the passage of the fight from standing (*tachi-waza*) to ground work (*ne-waza*) positions. Finally, the counterattack is the ability to perform a technique from an action initiated by the opponent.

Data collection

An Excel spreadsheet was necessary to collect data from official videos of medallists' Olympic judo fights. Data collection was made possible thanks to the International Olympic Committee's Multimedia Library (<http://extranet.olympic.org>). Our doctoral dissertation studied the offensive activity of the medallists at the 2004-2012 Olympic Games (Ait Ali Yahia, 2015). Two years later we examined the fights from Rio de Janeiro 2016. Previous research rechecked this data (Ait Ali Yahia, 2019, 2020, 2021).

Ethics

When consent is impractical or difficult to get and the advantages of the proposed study outweigh the disadvantages, researchers could proceed without authorization (Porsdam Mann et al., 2016). Sensitive data that third parties could misuse were not collected. We guaranteed the confidentiality and anonymity of these participants. There are no ethical issues in studying primary data collected from sports events, generated by a structured observation.

Sample Variables

The variables of this study are technical action, technical group (*nage-waza*, *ne-waza*), score and tactical action. An attempted attack is an action that respects *kuzushi* (breaking the balance), *tsukuri* (positioning the body) and *kake* (throwing phase) without scoring. In contrast, an effective attack is an action the referee awards a score for. Also, the present research assessed the frequencies and effectiveness of all tactical actions in percentage values (%). A tactical action is effective when it is associated with an attack rewarded by the referee. The study compared these tactical actions in an inter-Olympic analysis (longitudinal) and intra-Olympic analysis (cross-sectional).

Statistical Analysis

The Kolmogorov-Smirnov test assessed the normality of the collected data, while the Levene's test showed the equality of variance. Descriptive data is presented as the maximum, minimum, median (first quartile, third quartile), mean, and standard deviation with 95% of confidence intervals (95% CI). One-way analysis of variance conducted inter-Olympic (longitudinal study) and intra-Olympic (cross-sectional study) comparisons, followed by the Bonferroni test. Eta squared η^2 calculated the effect size (small= 0.009, medium= 0.058, and large= 0.137) (Cohen, 1988). Cohen's *d* determined the effect size for Student's *t*-test. Challenging Cohen's approach, Hopkins (2002)

proposed a Likert scale of sizes: trivial: 0.0-0.2, small: 0.2-0.6, medium: 0.6-1.2, large: 1.2-2.0, very large: 2.0-4.0, and nearly perfect: >4.0. Data was analysed using IBM SPSS predictive analytics software (version 27.0.1.0, SPSS, Inc., Chicago, IL, USA). The significance level was set at 5%.

RESULTS

Frequencies of Tactical Actions by Olympic Cycle

Tactical actions frequencies (%) of medallists are presented in Table 2. There was an effect of tactical actions chosen by medallists in Athens ($F_{2,270} = 356.240$, $p = 0.000$, $\eta^2 = 0.917$, large), Beijing ($F_{2,270} = 683.682$, $p = 0.000$, $\eta^2 = 0.955$, large), London ($F_{2,270} = 356.764$, $p = 0.000$, $\eta^2 = 0.917$, large), and Rio ($F_{2,270} = 741.946$, $p = 0.000$, $\eta^2 = 0.958$, large).

Concerning Athens medallists, the *post hoc* Bonferroni test identified differences between tactical actions. The direct attack presented a higher frequency compared with the combination ($p = 0.000$, 95% CI [54.1, 66.2], $d = 5.130$, nearly perfect), counterattack ($p = 0.000$, 95% CI [57.4, 69.5], $d = 5.890$, nearly perfect), standing to ground transition ($p = 0.000$, 95% CI [58.9, 71.0], $d = 6.143$, nearly perfect), feint ($p = 0.000$, 95% CI [64.2, 76.3], $d = 6.987$, nearly perfect), and repeat attack ($p = 0.000$, 95% CI [63.8, 75.9], $d = 6.924$, nearly perfect). The combination showed a higher frequency than feint ($p = 0.000$, 95% CI [4.1, 16.2], $d = 1.586$, large) and repeat attack ($p = 0.000$, 95% CI [3.6, 15.7], $d = 1.502$, large). Counterattack presented a higher frequency compared with feint ($p = 0.015$, 95% CI [0.8, 12.9], $d = 1.533$, large) and repeat attack ($p = 0.032$, 95% CI [0.3, 12.4], $d = 1.408$, large).

The *post hoc* Bonferroni test confirmed differences for Beijing medallists. The direct attack presented a higher frequency compared with the combination ($p = 0.000$, 95% CI [63.7, 73.2], $d = 8.580$, large), counterattack ($p = 0.000$, 95% CI [65.6, 75.0], $d = 8.369$, nearly perfect), standing to ground transition ($p = 0.000$, 95% CI [61.8, 71.2], $d = 8.006$, nearly perfect), feint ($p = 0.000$, 95% CI [70.5, 80.0], $d = 10.492$, nearly perfect), and repeat attack ($p = 0.000$, 95% CI [71.2, 80.7], $d = 10.758$, nearly perfect). The combination showed a higher frequency than the feint ($p = 0.000$, 95% CI [2.1, 11.5], $d = 1.719$, large) and repeat attack ($p = 0.000$, 95% CI [2.8, 12.3], $d = 2.002$, very large). Counterattack presented a higher frequency than feint ($p = 0.033$, 95% CI [0.2, 9.7], $d = 1.037$, medium) and repeat attack ($p = 0.007$, 95% CI [0.9, 10.4], $d = 1.231$, large). Standing to ground transition showed a higher frequency than feint ($p = 0.000$, 95% CI [4.0, 13.5], $d = 1.908$, large) and repeat attack ($p = 0.000$, 95% CI [4.7, 14.2], $d = 2.146$, very large).

Table 2. Frequencies (%) of tactical actions by Olympic cycle

		Direct attack	Combination	Counterattack	SGT	Feint	Repeat attack
	(Min; Max)	(20.0; 97.4)	(0.0; 36.0)	(0.0; 20.0)	(0.0; 18.8)	(0.0; 9.1)	(0.0; 8.0)
Athens	Med (Q ₁ ; Q ₃)	74.3 (66.4; 78.6)	8.5 (4.9; 17.9)	6.3 (3.1; 11.2)	5.2 (2.8; 8.7)	0.0 (0.0; 1.7)	0.0 (0.0; 2.8)
	M±SD	71.4±14.1	11.3±8.8	8.0±5.9	6.5±5.1	1.2±2.2	1.6±2.4
	(Min; Max)	(50.0; 100.0)	(0.0; 20.7)	(0.0; 29.2)	(0.0; 24.2)	(0.0; 8.1)	(0.0; 3.2)
Beijing	Med (Q ₁ ; Q ₃)	75.7 (72.7; 81.7)	7.9 (3.0; 10.1)	4.3 (0.9; 8.5)	8.1 (6.6; 12.6)	0.0 (0.0; 0.0)	0.0 (0.0; 0.0)
	M±SD	76.1±10.0	7.6±5.3	5.8±6.5	9.6±6.2	0.8±1.9	0.1±0.6
	(Min; Max)	(38.2; 100.0)	(0.0; 32.1)	(0.0; 23.5)	(0.0; 28.9)	(0.0; 20.0)	(0.0; 4.3)
London	Med (Q ₁ ; Q ₃)	71.8 (64.6; 81.8)	6.6 (3.2; 10.6)	2.8 (0.0; 4.6)	9.8 (5.8; 14.2)	0.0 (0.0; 2.2)	0.0 (0.0; 0.0)
	M±SD	73.7±14.0	8.4±7.6	4.4±5.6	10.6±8.0	2.2±4.9	0.6±1.3
	(Min; Max)	(57.1; 95.5)	(0.0; 22.6)	(0.0; 19.0)	(0.0; 14.3)	(0.0; 14.3)	(0.0; 6.7)
Rio	Med (Q ₁ ; Q ₃)	75.7 (69.5; 82.1)	10.3 (5.1; 13.0)	4.4 (0.0; 7.8)	5.4 (3.0; 7.8)	0.0 (0.0; 2.7)	1.2 (0.0; 3.3)
	M±SD	75.4±9.5	9.6±5.8	5.4±5.3	5.6±4.0	2.2±4.0	1.9±2.1

Min: Minimum; Max: Maximum; Med: Median; Q1: first quartile; Q3: third quartile; M: Mean; SD: Standard Deviation; Standing to Ground Transition: SGT.

ANOVA showed differences between tactical actions that occurred in London. The direct attack presented a higher frequency compared with the combination ($p = 0.000$, 95% CI [59.0, 71.6], $d = 5.800$, nearly perfect), counterattack ($p = 0.000$, 95% CI [63.1, 75.6], $d = 6.502$, nearly perfect), standing to ground transition ($p = 0.000$, 95% CI [56.8, 69.4], $d = 5.529$, nearly perfect), feint ($p = 0.000$, 95% CI [65.2, 77.8], $d = 6.811$, nearly perfect), and repeat attack ($p = 0.000$, 95% CI [66.8, 79.4], $d = 7.341$, nearly perfect). The combination showed a higher frequency than repeat attack ($p = 0.005$, 95% CI [1.5, 14.1], $d = 1.431$, large). Standing to ground transition showed a higher frequency than feint ($p = 0.001$, 95% CI [2.1, 14.7], $d = 1.272$, large) and repeat attack ($p = 0.000$, 95% CI [3.7, 16.3], $d = 1.743$, large).

The statistical analysis found differences between the tactical actions of Rio medallists. The direct attack presented a higher frequency compared with the combination ($p = 0.000$, 95% CI [61.3, 70.2], $d = 8.337$, nearly perfect), counterattack ($p = 0.000$, 95% CI [65.5, 74.5], $d = 9.059$, nearly perfect), standing to ground transition ($p = 0.000$, 95% CI [65.3, 74.2], $d = 9.556$, nearly perfect), feint ($p = 0.000$, 95% CI [68.7, 77.7], $d = 10.027$, nearly perfect), and repeat attack ($p = 0.000$, 95% CI [69.0, 78.0], $d = 10.646$, nearly perfect). The combination showed a higher frequency than feint ($p = 0.000$, 95% CI [3.0, 11.9], $d = 1.502$, large) and repeat attack ($p = 0.000$, 95% CI [3.3, 12.2], $d = 1.777$, large).

Inter-Analysis of Tactical Actions

ANOVA did not reveal differences between direct attacks ($F_{2,689} = 0.806$, $p = 0.493$, $\eta^2 = 0.022$, small), combinations ($F_{2,689} = 1.472$, $p = 0.226$, $\eta^2 = 0.039$, small), counterattacks ($F_{2,689} = 1.907$, $p = 0.133$, $\eta^2 = 0.050$, small), and feints ($F_{2,689} = 1.138$, $p = 0.337$, $\eta^2 = 0.031$, small). However, statistical analysis shows differences between standing to ground transitions ($F_{2,689} = 4.549$, $p = 0.005$,

$\eta^2 = 0.112$, medium) and repeat attacks ($F_{2,689} = 6.167$, $p = 0.001$, $\eta^2 = 0.146$, large). The *post hoc* Bonferroni test confirmed differences in standing to ground transitions. London medallists showed a higher percentage than medallists of Rio ($p = 0.013$, 95% CI [0.7, 9.4], $d = 0.799$, medium). Concerning repeat attacks, the *post hoc* test indicated differences. Medallists of Beijing showed a shorter percentage than medallists of Athens ($p = 0.010$, 95% CI [0.3, 2.8], $d = 0.863$, medium) and Rio medallists ($p = 0.002$, 95% CI [0.5, 3.8], $d = 1.129$, medium).

Tactical Actions Effectiveness by Olympic Cycle

Table 3 shows ratios of tactical actions effectiveness. There was an effect of effectiveness tactical actions of medallists in Athens ($F_{2,270} = 50.684$, $p = 0.000$, $\eta^2 = 0.610$, large), Beijing ($F_{2,270} = 65.877$, $p = 0.000$, $\eta^2 = 0.670$, large), London ($F_{2,270} = 20.720$, $p = 0.000$, $\eta^2 = 0.390$, large), and Rio ($F_{2,270} = 29.168$, $p = 0.000$, $\eta^2 = 0.474$, large).

The statistical analysis identified differences between the effectiveness of tactical actions developed in Athens. The direct attack presented higher effectiveness compared with the combination ($p = 0.000$, 95% CI [26.9, 50.5], $d = 1.877$, large), counterattack ($p = 0.000$, 95% CI [24.8, 48.4], $d = 1.715$, large), standing to ground transition ($p = 0.000$, 95% CI [33.2, 56.8], $d = 2.187$, very large), feint ($p = 0.000$, 95% CI [42.5, 66.1], $d = 2.994$, very large), and repeat attack ($p = 0.000$, 95% CI [41.2, 64.8], $d = 2.870$, very large). The combination showed a higher effectiveness than feint ($p = 0.002$, 95% CI [3.8, 27.4], $d = 1.597$, large) and repeat attack ($p = 0.006$, 95% CI [2.5, 26.1], $d = 1.379$, large). Counterattack presented a higher effectiveness compared with feint ($p = 0.000$, 95% CI [5.9, 29.5], $d = 1.568$, large) and repeat attack ($p = 0.001$, 95% CI [4.7, 28.3], $d = 1.389$, large).

Table 3. Effectiveness (%) of tactical actions by Olympic cycle

	Direct attack	Combination	Counterattack	SGT	Feint	Repeat attack
(Min; Max)	(0.0; 100.0)	(0.0; 45.5)	(0.0; 50.0)	(0.0; 50.0)	(0.0; 8.3)	(0.0; 25.0)
Athens Med (Q ₁ ; Q ₃)	52.8 (38.3; 67.9)	16.7 (0.0; 25.0)	15.5 (0.0; 29.8)	0.0 (0.0; 17.5)	0.0 (0.0; 0.0)	0.0 (0.0; 0.0)
M±SD	54.6±25.6	15.9±13.7	18.0±15.9	9.6±13.8	0.3±1.6	1.6±5.2
(Min; Max)	(33.3; 100.0)	(0.0; 50.0)	(0.0; 66.7)	(0.0; 42.9)	(0.0; 12.5)	(0.0; 0.0)
Beijing Med (Q ₁ ; Q ₃)	57.1 (41.5; 75.0)	13.4 (0.0; 25.9)	0.0 (0.0; 20.0)	13.4 (0.0; 25.0)	0.0 (0.0; 0.0)	0.0 (0.0; 0.0)
M±SD	59.6±21.3	14.2±14.9	12.0±18.8	13.8±14.2	0.4±2.4	0.0±0.0
(Min; Max)	(0.0; 100.0)	(0.0; 100.0)	(0.0; 100.0)	(0.0; 75.0)	(0.0; 11.1)	(0.0; 50.0)
London Med (Q ₁ ; Q ₃)	53.6 (38.3; 68.8)	0.0 (0.0; 20.6)	0.0 (0.0; 28.8)	0.0 (0.0; 33.3)	0.0 (0.0; 0.0)	0.0 (0.0; 0.0)
M±SD	52.2±32.0	11.3±21.5	17.4±28.0	15.4±21.3	0.4±2.1	2.7±10.4
(Min; Max)	(16.7; 100.0)	(0.0; 60.0)	(0.0; 75.0)	(0.0; 60.0)	(0.0; 25.0)	(0.0; 33.3)
Rio Med (Q ₁ ; Q ₃)	50.0 (25.0; 66.7)	13.3 (0.0; 22.9)	0.0 (0.0; 33.3)	18.3 (0.0; 27.1)	0.0 (0.0; 0.0)	0.0 (0.0; 0.0)
M±SD	48.1±22.1	14.1±16.5	15.9±20.7	16.5±17.4	1.5±5.6	3.8±8.9

Min: Minimum; Max: Maximum; Med: Median; Q1: first quartile; Q3: third quartile; M: Mean; SD: Standard Deviation; Standing to Ground Transition: SGT.

For Beijing medallists, the post hoc test confirmed differences. The direct attack presented higher effectiveness compared with the combination ($p = 0.000$, 95% CI [33.9, 56.7], $d = 2.469$, very large), counterattack ($p = 0.000$, 95% CI [36.2, 59.0], $d = 2.372$, very large), standing to ground transition ($p = 0.000$, 95% CI [34.4, 57.2], $d = 2.532$, very large), feint ($p = 0.000$, 95% CI [47.7, 70.5], $d = 3.905$, very large), and repeat attack ($p = 0.000$, 95% CI [48.1, 71.0], $d = 3.959$, very large). The combination showed higher effectiveness than feint ($p = 0.006$, 95% CI [2.4, 25.2], $d = 1.297$, large) and repeat attack ($p = 0.004$, 95% CI [2.8, 25.7], $d = 1.365$, large). Counterattack presented shorter effectiveness compared with feint ($p = 0.046$, 95% CI [0.1, 22.9], $d = 0.862$, medium) and repeat attack ($p = 0.032$, 95% CI [0.6, 23.4], $d = 0.902$, medium). Standing to ground transition showed higher effectiveness than feint ($p = 0.010$, 95% CI [1.9, 24.7], $d = 1.311$, large) and repeat attack ($p = 0.000$, 95% CI [2.4, 25.2], $d = 1.373$, large).

ANOVA showed differences between the effectiveness of tactical actions that occurred in London. The direct attack presented higher effectiveness compared with the combination ($p = 0.000$, 95% CI [23.6, 58.2], $d = 1.499$, large), counterattack ($p = 0.000$, 95% CI [17.5, 52.1], $d = 1.156$, medium), standing to ground transition ($p = 0.000$, 95% CI [19.5, 54.2], $d = 1.353$, large), feint ($p = 0.000$, 95% CI [34.5, 69.1], $d = 2.281$, very large), and repeat attack ($p = 0.000$, 95% CI [32.2, 66.8], $d = 2.078$, very large).

For Rio medallists, the post hoc test revealed differences between the effectiveness of tactical actions that appeared in Rio. The direct attack presented higher effectiveness compared with the combination ($p = 0.000$, 95% CI [21.0, 47.0], $d = 1.742$, large), counterattack ($p = 0.000$, 95% CI [19.2, 45.2], $d = 1.502$, large), standing to ground transition ($p = 0.000$, 95% CI [18.6, 44.7], $d = 1.588$, large), feint ($p = 0.000$, 95% CI [33.6, 59.7], $d = 2.891$, very large),

and repeat attack ($p = 0.000$, 95% CI [31.3, 57.4], $d = 2.630$, very large). Feint presented shorter effectiveness compared with the counterattack ($p = 0.018$, 95% CI [1.4, 27.5], $d = 0.951$, medium) and standing to ground transition ($p = 0.011$, 95% CI [2.0, 28.1], $d = 1.162$, medium).

Inter-Analysis of Tactical Actions Effectiveness

A one-way ANOVA revealed no significant differences between direct attacks ($F_{2,689} = 0.971$, $p = 0.409$, $\eta^2 = 0.026$, small), combinations ($F_{2,689} = 0.356$, $p = 0.785$, $\eta^2 = 0.010$, small), counterattacks ($F_{2,689} = 0.454$, $p = 0.715$, $\eta^2 = 0.012$, small), standing to ground transitions ($F_{2,689} = 0.890$, $p = 0.449$, $\eta^2 = 0.024$, small), feints ($F_{2,689} = 0.798$, $p = 0.498$, $\eta^2 = 0.022$, small), and repeat attacks ($F_{2,689} = 1.364$, $p = 0.258$, $\eta^2 = 0.037$, small).

Frequencies and Effectiveness of Tactical Actions in Four Olympics Games

Table 4 shows frequencies and effectiveness of all Olympics Games. The analysis of variance highlighted a significant difference between the frequencies of tactical actions ($F_{2,270} = 1578.278$, $p = 0.000$, $\eta^2 = 0.980$, large) and their effectiveness ($F_{2,270} = 148.124$, $p = 0.000$, $\eta^2 = 0.821$, large).

Regarding frequencies, direct attack presented a higher frequency compared with the combination ($p = 0.000$, 95% CI [62.6, 68.5], $d = 11.759$, nearly perfect), counterattack ($p = 0.000$, 95% CI [66.3, 72.2], $d = 12.722$, nearly perfect), standing to ground transition ($p = 0.000$, 95% CI [64.1, 70.0], $d = 12.388$, nearly perfect), feint ($p = 0.000$, 95% CI [70.4, 76.3], $d = 14.784$, nearly perfect), and repeat attack ($p = 0.000$, 95% CI [70.8, 76.7], $d = 14.979$, nearly perfect). The combination showed a higher frequency than counterattack ($p = 0.005$, 95% CI [0.8, 6.7], $d = 1.026$, medium), feint ($p = 0.000$, 95% CI [4.9, 10.8], $d = 2.782$, very large), and repeat attack ($p = 0.000$, 95% CI [5.3, 11.2], $d = 2.970$, very large). Feint presented a shorter frequency compared with a counterattack ($p = 0.001$,

Table 4. Frequencies and effectiveness of tactical actions in four Olympics Games

	Direct attack	Combination	Counterattack	SGT	Feint	Repeat attack
(Min; Max)	(53.4; 89.1)	(2.6; 17.6)	(1.1; 16.5)	(2.1; 15.5)	(0.0; 5.0)	(0.0; 3.2)
Frequencies Med (Q ₁ ; Q ₃)	74.0 (71.3; 79.1)	9.1 (6.2; 12.0)	5.0 (3.2; 7.9)	7.3 (5.7; 9.5)	1.0 (0.6; 2.0)	0.8 (0.5; 1.8)
M±SD	74.8±6.9	9.3±3.8	5.6±3.4	7.8±3.3	1.4±1.3	1.1±0.9
(Min; Max)	(30.4; 84.0)	(4.0; 39.1)	(0.0; 35.0)	(3.3; 40.0)	(0.0; 8.3)	(0.0; 8.3)
Effectiveness Med (Q ₁ ; Q ₃)	53.4 (47.4; 63.5)	12.8 (10.0; 19.3)	14.6 (6.2; 23.8)	12.0 (6.3; 19.3)	0.0 (0.0; 0.0)	0.0 (0.0; 3.8)
M±SD	54.1±13.3	14.6±7.5	15.3±10.1	13.6±8.9	0.8±2.0	1.7±2.9

Min: Minimum; Max: Maximum; Med: Median; Q₁: first quartile; Q₃: third quartile; M: Mean; SD: Standard Deviation; Standing to Ground Transition: SGT.

95% CI [1.2, 7.1], $d = 1.632$, large) and standing to ground transition ($p = 0.000$, 95% CI [3.4, 9.3], $d = 2.552$, very large). Repeat attack showed a shorter frequency than counterattack ($p = 0.000$, 95% CI [1.5, 7.4], $d = 1.809$, large) and standing to ground transition ($p = 0.000$, 95% CI [3.8, 9.7], $d = 2.770$, very large).

For the tactical actions' effectiveness, the post hoc test confirmed differences. The direct attack presented higher effectiveness compared with the combination ($p = 0.000$, 95% CI [33.0, 46.0], $d = 3.659$, very large), counterattack ($p = 0.000$, 95% CI [32.3, 45.3], $d = 3.286$, very large), standing to ground transition ($p = 0.000$, 95% CI [34.0, 47.0], $d = 3.579$, very large), feint ($p = 0.000$, 95% CI [46.7, 59.7], $d = 5.604$, very large), and repeat attack ($p = 0.000$, 95% CI [45.8, 58.8], $d = 5.444$, very large). Feint showed a shorter effectiveness than combination ($p = 0.000$, 95% CI [7.2, 20.2], $d = 2.514$, very large), counterattack ($p = 0.000$, 95% CI [7.9, 20.9], $d = 1.992$, large), and standing to ground transition ($p = 0.000$, 95% CI [6.2, 19.2], $d = 1.984$, large). Repeat attack presented a shorter effectiveness compared with the combination ($p = 0.000$, 95% CI [6.3, 19.3], $d = 2.269$, very large), counterattack ($p = 0.000$, 95% CI [7.0, 20.0], $d = 1.830$, large), and standing to ground transition ($p = 0.000$, 95% CI [5.3, 18.3], $d = 1.798$, large).

DISCUSSION

The main findings of the current study found the dominance of direct attacks compared with other tactical actions. In its turn, there was no significant difference between direct attacks at these four tournaments. The preponderance of direct attacks corroborates the findings of previous studies. As an illustration, Polish judo athletes, Polish medallists and Croatian judo athletes produced 87.9% (Sterkowicz & Maslej, 1999), 72.9% (Sterkowicz et al., 2007), and 94.9% (Sertic et al., 2016) of direct attacks respectively. At the London Olympic Games, medallists of the category (-81 kg) carried out 78.2% (Ait Ali Yahia, 2014), whereas Japanese judo athletes performed 66.6% at the 2010 World Championships (Abdel Raouf & Abdelhalem, 2011). Arguably, throwing the opponent through a direct attack remains delicate for elite judo athletes (Kashiwasaki & Nakanishi, 1992). The brevity of the opportune moment to execute a technique justifies this complexity (Inogai & Habersetzer, 2001). As a result,

pragmatism prevailed among these Olympic medallists, to the detriment of excessive risk-taking.

Although direct attacks were the most effective, other options contributed favourably to offensive activity. From the conceptual and creative standpoint, Inogai and Habersetzer (2001) have considered the indirect attack as the peak of the tactical building in a judo fight. In addition, the present study confirmed the medallists' richness of indirect tactical actions. Various configurations illustrated Olympic judo competitions. Medallists of Athens used the combination more often than counterattack, standing to ground transition, repeat attack, and feint. In Beijing and London, medallists chose the standing to ground transition more frequently than combination, counterattack, feint, and repeat attack. However, in Rio, medallists selected the combination first, followed by standing to ground transition, counterattack, feint, and repeat attack. But only standing to ground transition and repeat attack confirmed their differences. These trends resulted from the International Judo Federation's refereeing rules change, which affected the elite judo tactical approach. For illustration, Barreto et al. (2022) cited the sanction with exceptions, in 2010, of a direct attack with hands below the belt by *hansoku-make*. Since 2013, no exceptions accorded to this rule; the golden score time became unlimited, and *osae-komi* was still valid outside the area.

Besides the dominance of the direct attack, it is interesting to note that the other additional options contributed favourably to the offensive activity. Overall, the statistical analysis showed the preference of medallists for the combination first, followed by standing to ground transition, counterattack, feint, and repeat attack. International coaches argued that combinations and counterattacks are essential (Santos et al., 2015). Indeed, earlier studies validated their implication in high-level competitions. The works of Sterkowicz and Maslej (1999), Akhmedov et al. (2020), and Shavkatovich (2020) confirmed these low values of counterattacks. Contrary to expectations, Sterkowicz et al. (2007) and Boguszewski (2011) found 17.2% and 19.1%, respectively. Regarding combination, Sterkowicz and Maslej (1999) and Sterkowicz et al. (2007) highlighted 4.3% and 10.0%, respectively. The share of feint and repeated attacks has melted away; elite judo

athletes grant them little interest. No work has focused on these tactical actions because of their small impact.

In terms of effectiveness, direct attack stands out in absolute dominance ahead of counterattack, combination, standing to ground transition, repeat attack, and feint. Other works confirmed the supremacy of direct attack efficiency. Thus, Sterkowicz et al. (2007) discovered 62.4%, while Mayo et al. (2019) and Ito et al. (2019) detected 82.6% and 72.6%, respectively. In 2010, to make judo more attractive, IJF changed the refereeing rules to increase the scoring of direct attacks (Samuel et al., 2019). This rule change did not significantly increase the percentage of direct attacks' effectiveness. Statistically, no difference was observed between the four competitions. Using a direct attack allows an attack with efficiency. The attacker must relieve the weak points in the defensive organisation of the adversary, such as loss of balance, inefficient control of grip, momentary muscular relaxation, and an increase in breathing rate. It is the principle of opportunity (Inogai & Habersetzer, 2001).

Further, mistakes made by elite judo athletes caused the inefficiency of direct attack, combination, and counterattack. As mistakes, Oswald et al. (2011) observed the distance from the opponent, inadequate exploitation of opportunities, loss or insufficient control of grip, body position, deficient *kuzushi* and others. In addition, an effective combination requires the analysis of the attack distances, choosing the adequate throwing speed and fixing the same one-leg position to connect various techniques (Sarpanti, 2014). A combination requires speed and good timing to change tactics fluently in a fraction of a second (Inokuma & Sato, 1986). Takahashi et al. (2005) argued that combination is the most efficient due to the difficulty of countering it. In this context, Ito et al. (2014) noted that *ashi-waza* is the appropriate technical group because it can surprise the opponent. However, the combination solicited by medallists is higher than the 11.7% reported by Ito et al. (2019).

The *judoka* must expect the adversary to attack and re-attack by choosing an appropriate technique to counter effectively (Takahashi et al., 2005). The advantage of an effective counterattack is to create more psychological pressure on the opponent (Yanlong, 2019). Moreover, the athlete must discern, perceive and expect the opponent's intentions. He should have a fast decision-making capacity to neutralise the opponent's attacks, to increase the effectiveness of both attack and counterattack (Loio Pinto et al., 2020). Olympic medallists' counterattacks are more effective than the 8.9% determined in 56 final fights (Boguszewski, 2011). However, this outcome is contrary to 17.2% and 18.8%, established respectively by Mayo et al. (2019) and Ito et al. (2019).

Also, standing to ground transitions of Olympic medallists are less effective than the 21.4% achieved by male gold medallists at the Paris Grand Slam 2017 (Pierantozzi et

al., 2017). Agostinho and Franchini (2020) claimed that world champions presented a higher variation of ground transition sequences than the other medallists at the 2018 and 2019 world championships. Dopico Calvo et al. (2022) noticed that scored *tachi-waza* attacks 31.4% produced fewer ground transition sequences than unsuccessful *tachi-waza* attacks 68.6%. Therefore, the rhythm is a capital element to consider with an effective transition from standing combat to groundwork. The literature distinguished three distinct rhythms to pursue fighting on the ground: immediate, progressive and consecutive. At the 2017 World Championships, the immediate rhythm dominated the other types because of the high rate of scored *osae-komi-waza* actions. For the effective ground transition, an immediate rhythm is suitable for *osae-komi-waza*, while consecutive and progressive rhythms are appropriate for *kansetsu-waza* and *shime-waza* (Nagai et al., 2019). Rarely solicited by the Olympic medallists, feint and the repeated attack did not have the expected efficiency. Their low effectiveness is the consequence of weak frequencies.

For future competitions, coaches should consider these tactical action tendencies for improving the offensive system of their judo athletes. Indeed, the elite judo athlete must master the full range of these tactical actions, to be successful. Zadorozhna et al. (2021) confirmed that incorporating these tactical actions into their training programme, including the refereeing rules, should enhance their tactical knowledge.

Despite the relatively limited sample of elite athletes, chosen by weight category, this study is likely to contribute to our understanding of the tactical approach of Olympic medallists. The longer the fight duration, the greater the frequency of tactical actions can be. In a recent study, Ait Ali Yahia (2019) corroborated the difference in the offensive volume per fight between medallists' categories. Therefore, it should be interesting for other studies to determine the tactical profile of each weight category.

CONCLUSION

The present research has identified the tendencies of tactical actions used during these four competitions. Olympic medallists built an offensive system based on the direct attack first, followed by counterattack, combination, and standing to ground transition. These tactical actions proved their effectiveness in solving many complex defensive problems encountered in judo fights. Although feints and repeated attacks had a limited impact, their integration could be suitable, in crucial moments, to face a sophisticated defence. However, mastering a wide range of tactical actions is a capital condition for the elite judo athlete's success. Coaches should incorporate specific tasks that enhance the expertise of their athletes. These findings could improve elite judo athletes' practical approaches to tactics. Further research is required to establish how tactical actions affect success in different weight categories.

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