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Predominant technical actions used in the European judo championship
Acciones técnicas predominantes utilizadas en el campeonato europeo de judo

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Abstract. Judo is an Olympic combat sport that is divided into male and female weight categories. Each weight category implies significant differences in technical and strategic dimensions, as well as physiological, performance, and body composition among competitors. This study aimed to determine the technical actions predominance used by judokas in the European Judo Championship 2021. We observed 398 judo combats, in the various weight categories male and female, disputed in the European Judo Championship 2021. It was used an observation system in accordance with the classification of judo techniques proposed by Kodokan. An observation system was used according to the Kodokan classification of judo techniques. In Nage-Waza combat, there was a predominance leg technique (Ashi-Waza), arm technique (Te-Waza), hip technique (Koshi-Waza), side sacrifice techniques (Yoko-Sutemi-Waza) and frontal sacrifice techniques (Ma-Sutemi-Waza). When we focused our observation on the effectiveness of applied techniques, we observed more techniques scored with Ippon than Wazari. We can also observe that Shido was the significantly more recurrent punishment during male combats.
Keywords: Judo, Kodokan, European Championship, Combat performance, Competitive performance analysis.

Resumen. El judo es un deporte de combate olímpico que se divide en categorías de peso masculinas y femeninas. Cada categoría de peso implica diferencias significativas en dimensiones técnicas y estratégicas, así como fisiológicas, de rendimiento y composición corporal entre los competidores. Este estudio tuvo como objetivo determinar el predominio de las acciones técnicas utilizadas por los judocas en el Campeonato de Europa de Judo 2021. Observamos 398 combates de judo, en las distintas categorías de peso masculino y femenino, disputados en el Campeonato de Europa de Judo 2021. Se utilizó un sistema de observación de acuerdo con la clasificación de técnicas de judo propuesta por Kodokan. Se utilizó un sistema de observación según la clasificación Kodokan de técnicas de judo. En el combate Nage-Waza predominaron la técnica de piernas (Ashi-Waza), la técnica de brazos (Te-Waza), la técnica de cadera (Koshi-Waza), las técnicas de sacrificio lateral (Yoko-Sutemi-Waza) y las técnicas de sacrificio frontal (Ma -Sutemi-Waza). Cuando centramos nuestra observación en la efectividad de las técnicas aplicadas, observamos más técnicas puntuadas con Ippon que con Wazari. También podemos observar que Shido fue el castigo significativamente más recurrente durante los combates masculinos.
Palabras clave: Judo, Kodokan, Campeonato de Europa, Rendimiento en combate, Análisis del rendimiento competitivo.

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Introduction

Judo is a high-intensity Olympic combat sport, characterized by a series of acyclic movements with high technical mastery during combat (Norambuena et al. 2021). Judo is divided into male and female weight categories. Currently there are seven weight categories in the senior level, being the male categories -60kg, -66kg, -73kg, -81kg, -90kg, -100kg and +100kg and the female categories -48kg, -52kg, -57kg, -63kg, -70kg, -78kg and +78kg (Franchini et al, 2011).

Each weight category implies marked differences in technical and strategic dimensions, as well as physiological, performance, and body composition between different weight categories competitors (Franchini & Herrera-Valenzuela, 2017). This individual variability can broadly mark the options and predominance of biomechanical actions inherent to its own movements (Sterkowicz, Sacripanti, & Sterkowicz-Przybycien, 2013).

Given that judo is a dynamic and intermittent high-intensity sport it requires complex skills and tactical excellence for success (Degoutte, Jouanel, & Filaire, 2003; Franchini & Herrera-Valenzuela, 2017; Insua Iglesias et al, 2024). In each combat the judokas have to perform a large number of motor actions of technical aspect, making the physical demand high in each combat and consequently in each competition. Usually, to compete in a judo competition final stages, the medal-winning athletes have five to seven combats during international competitions. The time limit for each fight is 4 minutes, but if the judoka gets ippon (maximum score), the fight ends with his victory. On the other hand, since 2003, when the combat allocated time ends and we are faced with a technical draw (scores and penalties are equal for both athletes), the combat result is decided by Golden Score (Franchini, Takito & Calmet, 2013). Currently, if neither judoka gets any points in the golden score period, the fight continues indefinitely until a technical advantage or penalty arises for either athlete.

Today, a judo match can last from a few seconds to more than 12 minutes, depending on the score obtained by the competitors. However, a high-level judo match tends to last 3 minutes, with 20 to 30 seconds activity periods and 5 to 10 seconds of interruption. It is noted that a significant part of the matches last 3 to 4 minutes (Franchini & Herrera-Valenzuela, 2017).

The projection and immobilization techniques in judo are described and classified by the maximum entity of Judo, the Kodokan (Daigo, 2005). Five groups of projection techniques are identified (arm, hip, leg, frontal sacrifice and lateral sacrifice techniques) and three of ground action (immobilizations, keys and chokes). There are several studies that explore the athletes' technical behavior in competition based on the Kodokan classification (e.g. Sterkowicz, & Franchini, 2000; Van Malderen et al., 2006; Boguszewski,

2016), which essentially explore trends by gender and weight categories.

To be effective, judo techniques must be applied with precision, within a good opportunity, with strength, speed and power (Franchini et al., 2011). This movement precision implies biomechanical adaptations that can favor the coupling between athletes in their technical execution in competition.

More current research perspectives (Calmet & Ahmaidi 2004; Calmet, Trezel, & Ahmaidi 2006; Calmet, Miarka & Franchini 2010; Dopico-Calvo et al., 2022; Kashiwagura et al., 2021; Nagai et al., 2019) have sought, in addition to an interpretation of the predominance of the techniques used, have also investigated the tactical technical patterns that precede the technical actions, with the aim of identify attack systems, this perspective is very useful in the individual observation of the competitive performance of judokas.

However, the interpretation of temporal parameters during competitive practice is always interesting and pertinent, and specifically in judo, we have the examples of the work developed by Barreto et al. (2022) or Castarlenas & Planas (1997). In addition to the interest of this study perspective that allows us to interpret the competitive action in more detail, it is also important to reflect that according to the legal adaptations dictated by the rules of a modality, its study becomes necessary.

The evolution of how techniques are executed because of the rules changes since 2010 which conditioned the judokas' grips below the belt or in the pants, associated with the changes introduced in 2017 that aimed to make combat more dynamic, implied behavioral adaptations in judokas. Therefore, it is important to know in more detail the technical options and behaviors taken by athletes in combat today.

This work will allow us to explore current behavioral trends in high-level judo, exploring the most recent training trends in women's and men's judo, with a particular focus on Kodokan classification of technical projection actions in judo.

Methodology

Objectives

In the technical actions analysis used in the fights in analysis, all judokas used the same rules in combat, regardless of whether they are male or female. It was assumed that the frequency found for a certain technical class could be related to gender, to a weight category, to the stage and to the combat time.

Therefore, the formulation of the following objectives is justified.

1 – Determine the predominance of technical actions used by judokas at the 2021 European Judo Championship;

2 - Determine the predominance of scores obtained by judokas in the combats of the European Championship 2021;

3 - Determine the predominance of the punishments attributed to the judokas in the combats in the European Championships 2021;

4 - Determine the predominance of techniques used by judokas at the 2021 European Judo Championships depending on the combat phase (combat of normal duration and combat in the golden score phase)

5 - Determine the techniques predominantly used by judokas at the 2021 European Judo Championships according to the elapsed combat time.

Sample

The study sample focused on 398 judo fights, in the various weight categories, 230 male (57,8%) and 168 female (42,2%), disputed in the European Judo Championship 2021.

Instruments

We used an observation system created for this purpose, allowing the recording and categorization of each technical action performed by judokas observed in combat, according to the following variables described.

The independent variables considered were gender (female and male sexual dimorphism), weight categories respectively female and male: (-48kg/-60kg) light weight; (-52kg/-66kg) middle light weight, (-57kg/-73kg) light weight; (-63kg/-81kg) middle middle weight; (-70kg/-90kg) middle weight; (-78kg/-100kg) middle heavy weight; (+78kg/+100kg) heavy weight. The combat mode that can be categorized into Nage-Waza (standing combat) which involves the techniques of throwing a judoka to the ground in front of his opponent and Ne-Waza (ground combat) which can involve immobilization techniques or control of the opponent with the back on the ground, neck choke techniques or elbow joint dislocation techniques.

The combat phase that was categorized into combat time (normal combat time that goes from the first to the fourth minute of combat) and time in golden score (unlimited time after finishing the 4 minutes of combat).

The variable that assumes a characteristic as dependent is the technique class that can be categorized in Nage-Waza (parts of combat performed standing) as either a leg technique, where the predominant action to project the opponent is done with the leg (Ashi-Waza), hip technique, where the predominant action to project the opponent is done with hip action (Koshi-Waza), arm technique, where the predominant action to project the opponent is done with the action of the arms (Te-Waza), frontal sacrifice techniques, where the judoka sacrifices himself by projecting himself onto his back in order to project his opponent (Ma-Sutemi-Waza) and lateral sacrifice techniques, where the judoka sacrifices himself by projecting himself laterally to be able to project the opponent (Yoko-Sutemi-Waza). In Ne-Waza (parts of combat performed on the ground) the technique is categorized into immobilization technique, that is, techniques for immobilizing the opponent's torso on the ground (Osaekomi Waza), chokes technique, venous or

respiratory strangulation techniques to the opponent's neck (Shime Waza) and key technique, elbow joint dislocation techniques (Kansetsu Waza).

The score variable was categorized according to the effectiveness of the applied technical actions, which were evaluated in accordance with the current rules and validated by the referees, thus assuming a non-attribution of a score, or a submaximal score, that is, Wazari or a score maximum of Ippon.

The maximum Ippon score can be verified in the following ways:

when a judoka throws his opponent clearly with his back to the ground, with speed, strength and control;

-when a judoka immobilizes his opponent with his back on the ground, according to the techniques valid for this purpose for 20 seconds;

-when a judoka accumulates two maximum wazari advantages;

-when a judoka strangles his opponent's neck in a perfect way that leads to his opponent giving up;

-when a judoka applies a key (dislocation) to the elbow joint in a perfect way that leads to the opponent's withdrawal.

Wazari's submaximal score can be verified in the following ways:

-when a judoka throws his opponent onto the ground, where one or two essential elements (back on the ground, with speed, strength and control) are not present;

-when a judoka immobilizes his opponent with his back on the ground, according to the techniques valid for this purpose, between 10 and 19 seconds.

The sanctions were registered taking on the sum of punishments assigned by the referees, in accordance with the rules in force.

Punishments in judo can be shido or hansokumake.

Shido penalties are light penalties and allow the accumulation of up to a maximum of two penalties. The third shido penalty leads to the award of hansokumake.

Hansokumake is a serious penalty that implies the disqualification of the athlete, which can, in addition to the accumulation of three shido, also be attributed for disrespectful conduct by the judoka towards the opponent or referee, conduct that is dangerous to the physical integrity of the athlete or opponent himself. When these last described behaviors occur, the offending athlete may be directly sanctioned with hansokumake, implying immediate disqualification.

Two researchers of this study were responsible for the categorization and recording of each technical action. The intra and inter observer reliability analyses were calculated through Cohen's Kappa, in the analysis of 50 technical actions, where we obtained K values of 0.98, for a significance level of $p \leq 0.05$, which gives us an almost perfect interpretation between the subjects (Marôco, 2018).

Procedures

For this research preparation, no ethical issues involved in the analysis and interpretation of the data used were considered, since they were obtained using publicly available and freely accessible International Judo Federation (IJF) online sources, and were not generated by any experimentation process.

The athletes' personal identification was not done since the observation was not individualized. The identification of each observed combat was replaced by a code, which guaranteed anonymity and confidentiality.

Each technique was categorized according to the classification system proposed by Kodokan (Daigo, 2005). Data analysis was performed to identify each technique serving five categorization classes for Nage-Waza and three categorization classes for Ne-Waza, also used by other authors (Sterkowicz, & Franchini, 2000; Van Malderen et al., 2006; Boguszewski, 2016).

The techniques count distribution frequency was compared using the software IBM SPSS 21.0 software. For this purpose, cross-frequency tables were produced, where the association degree between variables was analyzed using the Chi Square test, where the significance level was set at $p \leq 0.05$. We complemented the association analysis between variables by calculating the adjusted standardized residuals, taking as reference positive values equal to or greater than 1.96, assuming that the higher the residual, the more significant the trend is (Marôco, 2018). In this study, the adjusted standardized residuals therefore give us a probability of the occurrence of a judoka's behavior depending on the time or combat phase, taking into account their sex or weight category.

To determine differences between groups in the frequencies recorded proportions, the Z test was applied, where the significance level was set at $p \leq 0.05$.

Results

In the present part of the study, we will describe the main findings in relation to the established objectives. According to Table 1 we observed that the technical actions hierarchy used globally in the combats analyzed in the Nage-Waza combat form were, leg technique (Ashi-Waza) (61.4%), arm technique (Te-Waza) (18.3%), hip technique (Koshi-Waza) (10.0%), lateral sacrifice techniques (Yoko-Sutemi-Waza) (5.3%), and frontal sacrifice techniques (Ma-Sutemi-Waza) (5.0%).

We also observed that the techniques most used by the female (67.1%) and male (56.5%) gender were the leg techniques (Ashi-Waza). There were significant differences between the genders ($p<0.01$) in favor of men in the use of arm techniques (Te-Waza) and fontal sacrifice techniques (Ma-Sutemi-Waza).

When we focus the observation taking into account the weight categories, we verified that there is a predominance of the use of leg techniques (Ashi-Waza) and arm techniques (Te-Waza). However, in the male categories, there was a significant association in the use of leg techniques (Ashi-

Waza) in the -73 Kg and +100 Kg categories; arms techniques (Te-Waza) in the categories of -66 Kg; frontal sacrifice techniques (Ma-Sutemi-Waza) in the -60 Kg category; and in the techniques of lateral sacrifice (Yoko-Sutemi-Waza) for the category of -60 Kg and -100 Kg.

In the female categories, significant associations were observed in the use of leg techniques (Ashi-Waza) in the -78 Kg category; in the use of (Koshi Waza) in the +78 Kg category; in the use of arm techniques (Te-Waza) in the -52 Kg category; in the use of frontal sacrifice technique (Ma-Sutemi-Waza) in the -57 Kg category; and lastly, in the use of lateral sacrifice techniques (Yoko-Sutemi-Waza) for the -70 Kg and +78 Kg category.

Table 1.
Cross frequency table between technique class and weight category by gender

Code	Total	Mal.	Fem.	Male Group/Weight Category							Female Group/Weight Category						
				-60 kg	-66 kg	-73 kg	- 81 kg	- 90 kg	-100 kg	+100 kg	-48 kg	-52 kg	-57 kg	-63 kg	-70 kg	-78 kg	+78 kg
AshW	4027	2005	2022	173	216	438*	392	285	256	245*	272	368	376	294	219	331*	162
KosW	656	315	341	31	42	56	66	54	46	20	32	52	68	67	32	42	48*
TW	1202	809#	393	109	165*	118	157	100	120	40	60	97*	60	68	61	23	24
SutW	326	257#	69	55*	33	41	60	31	29	8	6	9	27*	8	11	5	3
YSutW	347	160	187	30*	28	16	18	25	31*	12	12	26	25	35	34*	17	38*
Total	6558	3546	3012	398	484	669	693	495	482	325	382	552	556	472	357	418	275

Key: * (technical group shows a significant residue); # (technical group differs by gender); Mal (Male); Fem (Female); AshW (Ashi-Waza); KosW (Koshi-Waza); TW (Te-Waza); SutW (Ma-Sutemi-Waza); YSutW (Yoko-Sutemi-Waza); OskW (Osaekomi-Waza); ShiW (Shime-Waza); KstW (Kasetsu-Waza); Total (Total techniques).

Of 6733 projection techniques attempted by judokas in the evaluated fights, only 524 of the total technical actions were scored with a technical advantage of Wazari (3.3%) or Ippon (4.5%), with male athletes recording a higher effectiveness than female athletes.

In Table 2, we observe a predominance of the advantages thought out the weight categories. In the male group, there was a significant association with Ippon advantage in the +100 Kg category and Wazari advantage in the -100 Kg category. In the female group, Ippon showed a significant association in the +78 Kg category.

Table 2.
Cross frequency table between technique class and weight category as a result of the score obtained by gender.

Code	Total	Male	Female	Male Group/Weight Category							Female Group/Weight Category						
				-60 kg	-66 kg	-73 kg	- 81 kg	- 90 kg	-100 kg	+100 kg	-48 kg	-52 kg	-57 kg	-63 kg	-70 kg	-78 kg	+78 kg
Ippon	304	176#	128	17	24	31	34	26	19	25*	19	20	21	17	13	18	20*
Wazari	220	128#	92	17	21	18	17	15	30*	10	9	20	24	12	16	3	8
No Pont.	6205	3331#	2874	375	446	640	661	465	445	299	369	522	526	452	336	411	258
Kiken-Gachi	4	3	1	1	0	0	0	2*	0	0	0	0	0	0	0	1*	0
Total	6733	3638	3095	410	491	689	712	508	494	334	397	562	571	481	365	433	286

Key: * (technical group shows a significant residue); # (technical group differs by gender); Ippon (Maximal advantage); Wazari (Sub-maximal advantage); No Pont (No pontuable technics); Kiken-Gachi (Opponent's abandonment); Total (Total actions).

In Table 3, we can observe that Shido is the most reoccurring punishment during combat in both genders, registering a significant predominance in the male gender. In the male group, there was a significant association with Hansoku Make Direct in the -66 Kg category. In the female group, there were any significant associations in each weight category. Although there were no significant associations in the analysis by weight categories in both sexes, the male categories of -73 kg, -81 kg, -90 kg and -100 kg were the ones that committed the most fouls

Table 3.
Cross frequency table between punishment and weight category as a result of the score obtained by gender.

Code	Total	Mal.	Fem.	Male Group/Weight Category							Female Group/Weight Category						
				-60 kg	-66 kg	-73 kg	- 81 kg	- 90 kg	-100 kg	+100 kg	-48 kg	-52 kg	-57 kg	-63 kg	-70 kg	-78 kg	+78 kg
Shido	748	464#	284	49	58	81	95	70	70	41	46	41	43	46	34	39	35
Hansoku Make	71	39	32	3	3	10	10	5	6	2	8	2	3	4	3	7	5
Hansoku M. Direct	3	1	2	0	1*	0	0	0	0	0	0	0	1	0	1	0	0
Total	822	504	318	52	62	91	105	75	76	43	54	43	47	50	38	46	40

Key: * (punishment presents significant residue); # (punishment differs by gender); Shido (Light penalty); Hansoku Make (Severe penalty); Hansoku Make Direto (Severe penalty with direct expulsion); Total (Total penalties).

In the data in Table 4, we observe that in the combat phase the techniques most used by the female gender are the leg techniques (Ashi-Waza), an aspect similarly observed in the male gender, with the use of leg techniques (Ashi-Waza) and arms (Te-Waza) in equal proportions.

When we focus the observation taking into account the weight categories, we verified that there is a predominance of the use of leg techniques (Ashi-Waza) and arms (Te-Waza). However, in the male categories, there was a significant association in the use of leg techniques (Ashi-Waza) for the -73 Kg and +100 Kg category; in the use of arm techniques (Te-Waza) for the -60 Kg and -66 Kg categories;

in the use of sacrifice techniques (Ma-Sutemi-Waza and Yoko-Sutemiza-Waza) for the -60 Kg category. In the female categories, there was a significant association in the use of leg techniques (Ashi-Waza) for the -78 Kg category; in the use of hip techniques (Koshi-Waza) for the +78 Kg category; in the use of arm techniques (Te-Waza) for the -70 Kg category; in the use of sacrifice frontal techniques (Ma-Sutemi-Waza) for the -57 Kg category; and in the sacrifice lateral techniques (Yoko-Sutemi-Waza) for the -70 Kg and +78 Kg categories.

In the golden score phase, we observed that the techniques predominantly used by both genders were the Leg techniques (Ashi-Waza). Secondly, the male gender used more arm techniques (Te-Waza) comparing to the female gender. Also noteworthy at this stage is a lower use of frontal sacrifice techniques (Ma-Sutemi-Waza) by females, and reduction in the lateral sacrifice techniques (Yoko-Sutemi-Waza) by males.

When we focus on the observation taking into account the weight categories, we verified that there is a predominance of the use of leg (Ashi-Waza) and arm (Te-Waza) techniques. In the male categories, a significant association was observed in the use of arm techniques (Te-Waza) for the -66 Kg category; frontal sacrifice techniques (Ma-Sutemi-Waza), as well as lateral sacrifice techniques (Yoko-Sutemi -Waza) for the -60 Kg category. In the female categories there was a significant association in the use of arm techniques (Te-Waza) in the -48 Kg and -52 Kg categories.

Table 4.
Cross-frequency table between technique class and weight category, according to gender and by combat phase.

	Code	Total	Mal	Fem	Male Group/Weight Category							Female Group/Weight Category						
					-60 kg	-66 kg	-73 kg	- 81 kg	- 90 kg	-100 kg	+100 kg	-48 kg	-52 kg	-57 kg	-63 kg	-70 kg	-78 kg	+78 kg
Combat	AshW	3626	1810	1816	172	199	375*	321	257	242	244*	255	322	325	265	197	298*	154
	KosW	561	272	289	29	33	49	53	45	43	20	28	49	50	54	27	37	44*
	TW	1055	711	344	105*	140*	97	133	81	115	40	50	76	53	65	56*	20	24
	SutW	277	217	60	51*	27	34	43	27	27	8	6	9	22*	7	9	4	3
	YSutW	316	153	163	28*	26	16	17	23	31	12	10	23	19	30	29*	15	37*
	Total	5835	3163	2672	385	425	571	567	433	458	324	349	479	469	421	318	374	262
	Code	Total	Mal	Fem	Male Group/Weight Category							Female Group/Weight Category						
					-60 kg	-66 kg	-73 kg	- 81 kg	- 90 kg	-100 kg	+100 kg	-48 kg	-52 kg	-57 kg	-63 kg	-70 kg	-78 kg	+78 kg
Golden Score	AshW	399	193	206	1	17	63	71	27	14	1	17	46	51	29	22	33	8
	KosW	95	43	52	2	9	7	13	9	3	0	4	3	18	13	5	5	4
	TW	147	98	49	4	25*	21	24	19	5	0	10*	21*	7	3	5	3	0
	SutW	49	40	9	4*	6	7	17	4	2	0	0	0	5	1	2	1	0
	YSutW	31	7	24	2*	2	0	1	2	0	0	2	3	6	5	5	2	1
	Total	721	381	340	13	59	98	126	61	24	1	33	73	87	51	39	44	13

Key: * (technical group shows a significant residue); # (technical group differs by gender); Mal (Male); Fem (FemaleAshW (Ashi-Waza); KosW (Koshi-Waza); TW (Te-Waza); SutW (Ma-Sutemi-Waza); YSutW (Yoko-Sutemi-Waza); Total (Total techniques).

In the data presented in Table 5, we observe that the global values both in the combat phase and in the golden score phase indicate a greater predominance of use by judokas for leg techniques (Ashi-Waza), decreasing the use of arm techniques (Te -Waza), hip techniques (Koshi-Waza), side sacrifice techniques (Yoko-Sutemi-Waza) and frontal sacrifice techniques (Ma-Sutemi-Waza).

Table 5.
Cross-frequency table between technique class as a function of gender and combat time

Code	Total	Mal	Fem	Male Group/Combat Time				Female Group/Combat Time			
				1º m	2º m	3º m	4º m	1º m	2º m	3º m	4º m
AshW	3598	1791	1807	580*	512	451	248	631*	519	373	284
KosW	557	269	288	53	78	76	62*	75	88	75	50
TW	1028	689	339	166	209	189	125	85	99	93	62
SutW	276	216	60	64	55	56	41	18	24	9	9
YSutW	312	152	160	30	47	41	34*	41	44	48	27
Total	5711	3117	2654	893	904	813	510	850	774	598	432

Key: * (technical group shows a significant residue); # (technical group differs by gender); Mal (Male); Fem (Female);; AshW (Ashi-Waza); KosW (Koshi-Waza); TW (Te-Waza); SutW (Ma-Sutemi-Waza); YSutW (Yoko-Sutemi-Waza); Total (Total techniques).

In both men's and women's categories the number of entries decreases from the first to the fourth minute, especially in leg techniques (Ashi-Waza) and frontal sacrifice techniques (Ma-Sutemi-Waza).

In the remaining groups (Koshi-Waza, Te-Waza and Ma-Sutemi-Waza), we find oscillations throughout the combat period, which is possible to observe in most of the techniques. They tend to increase or maintain their predominance from the first to the second minute and, in turn, to decrease slightly from the second to the third minute and to decrease in the last minute.

In the male's categories, there were found significant associations in the use of leg techniques (Ashi-Waza) in the first minute of combat; in the use of hip techniques (Koshi-Waza) and lateral sacrifice techniques (Yoko-Sutemi-Waza) in the fourth minute of combat. In female's categories, it was found only significant associations in the use of leg techniques (Ashi-Waza) in the first minute of combat.

Discussion

The main findings demonstrated that the hierarchy of technical actions used globally in the combats analyzed in Nage-Waza were: leg technique (Ashi-Waza), arm technique (Te-Waza), hip technique (Koshi-Waza), side sacrifice techniques (Yoko-Sutemi-Waza) and frontal sacrifice techniques (Ma-Sutemi-Waza).

This evidence do not agree with the trends evidenced by Sterkowicz, Sacripanti & Sterkowicz-Przybycien (2013) or Kons et al. (2022 b), where in Nage-Waza the technical hierarchy was led by arm techniques, followed by leg techniques, sacrifice technics and hip techniques. In turn, Ait Ali Yahia (2020) and Ait Ali Yahia (2021) are in line with our findings, where they found a predominance of leg technique work. However, Ait Ali Yahia (2020, 2021), in their analyzes of the volume of techniques, the trend, particularly since the London 2012 Olympics, is towards higher values in the use of leg techniques, followed by arm techniques, sacrifice techniques and hip techniques. If we focus on the analysis of the classified athletes' repertoire, the highest values are for the use of leg techniques, followed by sacrifice techniques, arm techniques, and hip techniques.

The hierarchy of effectiveness according to the groups of techniques respected the hierarchy observed in the global analysis of the techniques in this study for the male categories, but not for the female categories. Franchini & Sterkowicz (1999 in Franchini, 2010), when studying athletes from Olympic Games and World Championships, observed that the hierarchy of techniques that conferred some points in Nage-Waza were first the leg techniques, followed by the arm techniques, sacrifice and hip.

Brown & McMurray (1997 in Franchini, 2010) when investigating the effectiveness of techniques at the Atlanta Olympics, the highest percentage of effectiveness with Ippon in Nage-Waza was in hip techniques (43%), followed by arm techniques (31%), sacrificial techniques (28%) and leg techniques (23%).

Although there were significant associations in the use of the various groups of techniques in Nage Waza in some weight categories, there was a great technical variability, in which no obvious prominent behavioral patterns were observed, as referenced by Batista et al. (2022).

When we focused our observation on the effectiveness of the applied techniques, we observed that were techniques scored with Ippon (N= 304; 4.5%) or Wazari (N= 220; 3.3%) technical advantages, and about 92% of non-scoring techniques. In the present study, in the male categories, the percentage of effectiveness with Ippon were 4.8% and Wazari 3.5 %, and in the female categories, the percentages of effectiveness in Ippon were 4.1% and Wazari 3 %. These values therefore gave a total percentage of effectiveness of 7.8%, of which 42% with the Wazari advantage and 58% with the Ippon advantage. These are lower values than those Batista et al. (2022) in the study they developed in fights at the finals of international competitions that could score for the Olympic ranking, when focused your observation on the techniques applied effectiveness, they observed that 11% of all technical actions were scored with a technical advantage of Wazari 60.2% and Ippon 39.8%, still, with inverse values, to what we obtained in the present study.

However, unlike what was observed by Sterkowicz, Sacripanti & Sterkowicz-Przybycien (2013) in the London Games, in the present study, the percentage of female effectiveness was lower than that of males, suggesting an evolution in the defensive capacity of women, as suggested by Batista et al. (2022), which may contradict what had been pointed out by Sterkowicz, Sacripanti & Sterkowicz-Przybycien (2013), as a justification for greater female effectiveness in London.

In the analysis of the data on the penalties committed by the judokas, a significant attribution of penalties was observed on the part of the male categories compared to the female categories. Boguszewski (2016) found inverse results, regarding average frequencies between genders, to those obtained in the present study. However, Sterkowicz, Sacripanti & Sterkowicz-Przybycien (2013) found the same more penalizing tendency for male judo, and even the female categories showed a significantly less penalizing attitude, in terms of lack of combativeness.

By concentrating our observation at the level of the combat phase, we found that the general hierarchy of technical resources was maintained from the combat phase to the golden score phase. This behavioral stability of judokas regarding decision-making in technical options, even with some percentage oscillations, was also observed by Batista et al. (2022).

It should be noted that an athlete's body proportionality must be related to their preferred techniques (Detanico & Santos, 2007), making it essential for judo performance, the judoka's commitment to maintaining the ideal weight, considering a body composition adequate to obtain physiological balance and motor efficiency (Almansba et al., 2010).

Technical variability has been shown to be decisive in the performance of judo athletes in World Championships (Agostinho & Franchini, 2021; Camargo et al., 2019; Martins et al., 2019). Kons et al. (2022) recommend that judo coaches and athletes maximize the technical repertoire, as greater variability is a determining factor for increasing the competitive performance of judo.

In the analysis we performed as a function of combat time, no significant differences were identified between combat minutes. Apparently, the standardization of world training tends to shape the technical options and their frequency of application in modern judo. Barretto et al. (2022) in their review and meta-analysis of men's judo combat time in international competitions between 2010 and 2019, observed that the average time (in seconds) of men's judo combat has changed (2010 = 202.8; 2011-2012 = 304.8; 2016 = 237.4; 2018-2019 = 189.8 s) after each rule change

(2010, 2013, 2017 and 2018). There were significant differences between matches that ended in regular time and those that required extra time (Golden Score: 2013 = 3% vs. 2018–2019 = 21%). There were also differences between the -60 kg and + 100 kg categories and the others in 2011-2012. However, the authors did not find significant differences between the fight time by weight division after the 2017 rules changes, although differences were still observed regarding the final time of the fights.

Conclusions

This chapter presents the main conclusions of this master's thesis. Given the research objectives, the most relevant conclusive traits were the following:

Objective 1 – Determine the predominance of technical actions used by judokas at the 2021 European Judo Championship.

Globally, the hierarchy of technical actions used in the matches analyzed in the Nage-Waza combat form were: leg technique (Ashi-Waza), arm technique, hip technique (Koshi-Waza), lateral sacrifice techniques (Yoko-Sutemi - Waza) and frontal sacrifice techniques (Ma-Sutemi-Waza).

Objective 2 - Determine the predominance of scores obtained by judokas in the combats of the 2021 European Judo Championship.

There was an effectiveness of 7.8% compared to all the technical actions categorized in Nage Waza. There was a predominance of Ippon's advantage over Wazari in most weight categories, with male athletes scoring significantly more than female athletes.

Objective 3 - Determine the predominance of punishments attributed to judokas in the 2021 European Judo Championship.

Shido's penalty was the most recurrent punishment during the combat in both genders, with the male group showing significant differences due to a higher record compared to the female group.

Objective 4 - Determine the predominance of techniques used by judokas at the 2021 European Judo Championships depending on the combat phase.

Globally, the predominance of technical actions used in the combat phase in Nage-Waza were, leg technique (Ashi-Waza), arm technique, hip technique (Koshi-Waza), lateral sacrifice techniques (Yoko-Sutemi-Waza) and frontal sacrifice techniques (Ma-Sutemi-Waza). In Golden score the trend was the same, reversing only the trend in sacrifice techniques.

Objective 5 - Determine the techniques predominantly used by judokas at the 2021 European Judo Championships according to the elapsed combat time.

Globally, the predominance of technical actions used as a function of combat time in Nage-Waza were leg technique (Ashi-Waza), arm technique, hip technique (Koshi-Waza), lateral sacrifice techniques (Yoko-Sutemi -Waza) and frontal sacrifice techniques (Ma-Sutemi-Waza). Although globally not linear, the trend of technical actions is decreasing, in the female group from the first to the fourth minute and in the male group from the second to the fourth minute.

The present work, despite presenting a technique classification method conventionally used in other works of technical analysis in judo, presents an interpretative limitation based on the absence of other technical-tactical indicators before the technical execution by the competitors.

It is suggested that in future studies that consider the technical interpretation from the perspective of Kodokan, information regarding the direction of imbalance and the direction of the attack also be integrated, as they are essential to identify an athlete's attack system and its effectiveness.

As practical applications of the results obtained in the present study, we present our proposals below.

Given that some associations in technical options in combat were evidenced in terms of judokas' gender and weight category, the connections found in this study, which can be justified by the projection techniques options, should be taken into consideration in the technical and tactical training of the competitors.

The somatotype must be considered when choosing the techniques that make up the technical-tactical system for the competition, always considering the opponent's height and the type of grips used.

The quantity and quality of technical and tactical actions performed by the competitors must be monitored during training and competitions, allowing a detailed analysis by combat phases and providing feedback, in order to best select the physical preparation means and stimulate technical and tactical preparation regarding the execution of counter-attack or combination techniques.

If combat timing influences tactical performance in each weight category, providing athletes with a prescribed cognitive and behavioral strategy to follow can help standardize the psychological factors that could contribute to judo.

The systematic methods development of technical, tactical and psychological observation can and should be a reference for coaches and analysts to identify judokas' optimal performances, allowing them more specific, precise, and facilitated comparative analyses.

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