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12. - 13. NOVEMBER 2025., ZAGREB – CROATIA

8th Scientific And Professional Conference

Applicable research in judo



Editors:
Hrvoje Sertić,
Sanda Čorak
Ivan Segedi



8TH SCIENTIFIC AND PROFESSIONAL CONFERENCE

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PROCEEDINGS BOOK

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Hrvoje Sertić, Ivan Segedi and Sanda Čorak

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University of Zagreb Faculty of Kinesiology
Croatian Judo Federation
European Judo Union

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FOREWORD

With great pleasure, we are organizing the scientific conference "Applicable research in judo" for the eighth time.

This year marks a significant anniversary, commemorating ten years since the organization of the first conference in 2015, also held in Zagreb—a milestone that fills us with immense pride.

Unfortunately, we had to cancel the conference organization for three consecutive years due to the pandemic in 2020, 2021, and 2022.

As we continue our efforts, we are eager to advance our journey, and judging by the number of submitted papers, as well as the quality and diversity of the presented topics, we are confident that this year's proceedings will rank among the highest quality in our history. The topics covered are wide-ranging, encompassing subjects from, WEIGHT LOSS AND NUTRITION, MEASUREMENT OF EXERCISE PERFORMANCE, PSYCHOLOGICAL ASPECTS IN JUDO, HEALTH, PREVENTION AND REHABILITATION, SOCIOLOGICAL ASPECTS IN JUDO to PREDICTION MODEL.

Once again, we are honored to host a diverse group of scholars and professionals from continents beyond Europe, reflecting the global nature of our conference. This international participation serves as evidence of the relevance and impact of the proceedings from our conference, which are read and cited by researchers worldwide.

This global engagement provides us with invaluable insights, knowledge, and enthusiasm, reinforcing our commitment to organizing the "Applicable..." conference with the same passion and excellence as in previous years. Since its inception in 2015, we have dedicated ourselves to establishing this conference as a leading professional and scientific forum for judo. Our ambition is to ensure that the results and findings discussed at this conference are transferred from "paper" to the judo mat, promoting practical application in the sport.

We extend our sincere gratitude to all those whose hard work and dedication have contributed to the quality of the conference, thereby increasing its recognition within the global judo community. Once again, thank you for your invaluable support.

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Long-Term Effects of Rapid Weight Loss in Former Judo Athletes: Preliminary Results

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ABSTRACT

In the first part of this paper, an overview is provided of previous research on the effects of body mass reduction on selected anthropological characteristics of judo athletes. Subsequently, the results of a study on the long-term impact of rapid weight loss (RWL) on the health status, dietary habits, and physical activity of former judo athletes are presented in a concise form. The findings indicate potential long-term negative consequences of practicing RWL on the aforementioned variables.

Keywords: *weight cutting, health, nutrition, physical activity*

INTRODUCTION

Unlike long-term caloric restriction, which has been shown to be beneficial for longevity and overall health (Redman *et al.*, 2008), constant fluctuations in body mass throughout life (so-called *weight cycling* or *yo-yo dieting*) may be highly detrimental. Although there is no universally accepted definition of weight cycling, it can be described as a pattern characterized by repeated periods of weight loss and subsequent regain (Strohacker *et al.*, 2009). Weight cycling is a phenomenon observed not only among combat sport athletes but also in obese individuals attempting to reduce body mass, and increasingly in people of normal body mass, particularly young women dissatisfied with their appearance. Its impact on health has been investigated primarily through cross-sectional surveys in humans and longitudinal endpoint studies in rodents (Strohacker *et al.*, 2009), with human research conducted predominantly in obese populations and focusing largely on post-diet body mass maintenance (Marquet *et al.*, 2013). Given that obesity has become one of the leading health problems in Western societies, it is unsurprising that it has attracted considerable scientific interest worldwide. Some studies suggest that weight cycling may be even more detrimental to the development of certain diseases than maintaining a stable body mass at an obese level (Jeffery, 1996). On the other hand, some studies have found no association between weight cycling and body composition, blood pressure, lipid profile, or risk of developing type 2 diabetes (Field *et al.*, 1999). Strohacker *et al.* (2009) suggested that the absence of negative effects in such studies may be due to the relatively short interval between episodes of weight cycling and the timing of the assessment.

In other words, a longer period may be required to detect the negative effects of weight cycling on health. Interestingly, these adverse effects appear to be reduced when weight cycling is accompanied by physical activity. Some authors have also suggested that the negative consequences of weight cycling may be more pronounced in individuals of normal body mass (Montani *et al.*, 2006). Montani *et al.* (2006) further reported that a higher prevalence of hypertension, accumulation of visceral fat, insulin resistance, and dyslipidemia is more likely to occur in weight cyclers of normal body mass, all of which may contribute to increased cardiovascular risk. In addition, fluctuations in cardiovascular risk factors, such as blood pressure, heart rate, sympathetic activity, blood glucose, and lipids, with probable repeated overshoots above normal values during periods of body mass regain, place additional stress on the cardiovascular system. Nevertheless, athletes represent a unique subpopulation characterized by specific physical and psychological traits, as well as distinct eating patterns shaped by the type of sport and training demands. For this reason, they are difficult to compare with non-athlete populations, particularly those with clinical and/or obesity issues, in the context of examining the long-term effects of weight cycling on anthropometric characteristics (Sundgot-Borgen & Torstveit, 2004).

Optimization of body mass and body composition is one of the key priorities for elite athletes in order to achieve top-level performance (Sundgot-Borgen, 1993). In addition, combat sport athletes often perceive rapid weight loss (RWL) as a demonstration of mental toughness that contributes to competitive success (Pettersson *et al.*, 2013). Interestingly,

in some sports disciplines (e.g., *shot put*), it is desirable to develop exceptionally high overall body mass, particularly muscle mass, in order to maximize absolute strength. In certain sports, this increase in total body mass is even more pronounced. For instance, in sumo wrestling, athletes pursue extreme body mass gains, including the accumulation of subcutaneous fat, as a means of gaining a competitive advantage over opponents. However, in many other sports, such as those with weight categories (e.g., *lightweight rowing, combat sports, weightlifting*), aesthetic sports (e.g., *gymnastics, figure skating*), endurance sports (e.g., *running or cycling*), and sports in which athletes must overcome gravitational forces (e.g., *high jump and pole vault*), low body mass and/or a low fat-to-muscle ratio (*leanness*) is considered crucial for optimizing performance (Hagmar et al., 2008). This is particularly relevant for weight-class sports, where athletes aim to sustain their body mass as close as possible to the upper category limit, thereby increasing their chances of competitive success (Artoli et al., 2016). Previous studies have shown that in such athletes, relative body mass variation during the season is significantly higher than in other sports (Hagmar et al., 2008).

However, striving for leanness may lead to impaired performance and adverse health outcomes if chronic energy deficiency develops (Loucks, 2004). In this context, women appear to be more vulnerable than men to harmful weight-control practices, which are frequently associated with eating disorders (Sundgot-Borgen & Torstveit, 2004). Such disorders can also be associated with amenorrhea and osteoporosis, three conditions that together constitute the well-known Female Athlete Triad, which is today often regarded as one of the most serious health concerns among elite female athletes (Loucks & Nattiv, 2005). Therefore, the International Olympic Committee issued a consensus statement addressing the issue of chronic energy deficiency in athletes attempting to manage body mass over extended periods, highlighting the potential detrimental effects on lean mass maintenance, immune function, bone health, metabolic rate, and hormonal processes (Mountjoy et al., 2014).

It is well known that judo athletes, both during the competitive season and throughout their sporting careers, engage not only in the constant maintenance of low body mass but also in repeated episodes of acute rapid weight loss (RWL) followed by rapid weight regain (RWR) after weigh-in. RWL is typically defined as a rapid reduction of body mass within a few days (*up to one week*) prior to competition, achieved through a variety of methods. This practice enables athletes to compete in lower weight categories while allowing sufficient time for recovery and restoration of performance levels before competition (Santos et al., 2024). Previous research on judo athletes has so far focused almost exclusively on the acute effects of RWL and/or RWR on selected anthropological characteristics.

PREVIOUS RESEARCH

General Characteristics of Acute Weight Reduction

Previous research indicates that approximately 86% of judo athletes engage in RWL, typically reducing around 5% of their body weight within 2–3 days before weigh-in (Artoli et al., 2010). The most common RWL methods are dehydration and food restriction; however, extreme practices are also frequently employed, such as exercising in rubber or plastic suits, taking diet pills, self-induced vomiting, water loading, sodium restriction, and even sleeping with the head tilted down to alter body fluid distribution (Santos et al., 2024). These methods can be extremely dangerous to athletes' health and, in some cases, even fatal (Crighton et al., 2016). It appears that the prevalence of RWL increases with competitive level and is higher among athletes in lower weight categories. Sex differences have been reported in wrestling (Viveiros et al., 2015) (*with females engaging in RWL even more frequently than males*) and in boxing (Reale, Cox, et al., 2017), but not in judo (Artoli et al., 2010) or taekwondo (da Silva Santos et al., 2016). It has also been established that weight cycling often begins during puberty (Artoli et al., 2010), which may negatively affect growth and development. Moreover, the earlier athletes begin engaging in weight cycling, the greater the risk of weight-loss-related health problems later on.

Impact on Psychological Parameters

According to Filaire et al. (2011) a significant increase in fatigue and anger was observed at follow-up assessment. In addition, tension and confusion also increased, with even higher levels of significance compared to baseline values. A decrease in vigor was reported, while depression remained unchanged among judo athletes. Koral and Dosseville (2009) found that acute RWL negatively affected short-term memory, vigor, concentration, and self-esteem, while increasing confusion, anger, fatigue, depression, and feelings of isolation. Other study suggested that even relatively moderate weight reduction through RWL (*approximately 5%*) can result in symptoms such as fatigue or weakness, dizziness,

feverishness, nausea, nosebleeds, headaches, hot flashes, cramps, and feelings of disorientation or anxiety (Alderman *et al.*, 2004). Prior to weigh-in, 10–20% of athletes who practice RWL show signs of eating disorders, and after competition this prevalence increases to 30–40% (Steen & Brownell, 1990). Constant preoccupation with body mass may also lead to other eating disorders, such as binge eating, anorexia, and bulimia, particularly among females (Sundgot-Borgen & Torstveit, 2004). Fortes *et al.* (2018) further reported negative effects of RWL on mood and sleep.

Impact on Physiological Parameters and Health

In the context of physiological characteristics, most studies indicate that RWL reduces both aerobic and anaerobic capacities. The decrease in aerobic capacity has been linked to dehydration, reduced plasma volume, increased heart rate, hydroelectrolytic disturbances, impaired thermoregulation, and muscle glycogen depletion (Fogelholm, 1994). The decline in anaerobic capacity has been associated with reduced buffering capacity, glycogen depletion, and hydroelectrolytic disturbances (Franchini *et al.*, 2012). It is important to emphasize that the degree of impairment in these capacities depends on the recovery time between weigh-in and competition. Evidence suggests that 3–4 hours after weigh-in is sufficient for athletes to restore anaerobic performance to baseline levels (Artoli *et al.*, 2010).

Previous studies have reported that RWL increases the likelihood of contracting infectious diseases (Filaire *et al.*, 2011). Some research also suggests that RWL may elevate the risk of injury (Green *et al.*, 2007; Lakicevic *et al.*, 2020), which is commonly explained by disrupted metabolism and altered muscle contraction patterns resulting from RWL.

Impact on competitive performance and pos-career health

Findings in this area are somewhat contradictory. On the one hand, several authors have reported that RWL and subsequent rapid body mass gain (RBG) can negatively affect athletic performance (Yang *et al.*, 2017). For example, dehydration exceeding 5% of body mass has been shown to impair performance, and complete rehydration is difficult to achieve within the typical recovery period (Reale, Slater, *et al.*, 2017). On the other hand, some studies have demonstrated that athletes who undergo greater body mass reductions during RWL may actually increase their chances of success in competition (Artoli *et al.*, 2010). It has also been established that judo athletes who begin weight reduction practices later in their careers and engage in fewer episodes of weight cycling per year tend to achieve better competitive results (Štangar *et al.*, 2022). All of the above studies have focused on the acute effects of RWL on the anthropological characteristics of judo athletes. However, only a few investigations have analyzed the long-term effects of weight cycling in athletes more generally, and none have been conducted exclusively on judo athletes.

Sa ni *et al.* (2006) reported greater body mass gain at a younger age among weight cyclers (*boxers, wrestlers, and weightlifters*) compared to other athletes and non-athletes. Interestingly, despite maintaining a healthier lifestyle, former athletes still experienced greater body mass increases than the non-athlete population, which the authors attributed to repeated cycles of weight loss and regain during their sporting careers. Although these athletes remained physically active, they likely exhibited a lower-than-expected basal energy expenditure, which contributed to greater weight gain. This assumption is supported by a cross-sectional study of 16-year-old wrestlers in which weight cycling was associated with a reduced resting metabolic rate (Steen *et al.*, 1988). In contrast, McCargar and Crawford (1992) did not find differences in metabolic rate between weight cyclers and non-cyclers in wrestling, suggesting that further research is necessary to confirm this hypothesis. Another possible explanation for greater post-career body mass among weight-cycling athletes is increased food intake, resulting from larger portion sizes and higher energy density associated with binge eating as a consequence of repeated weight cycling episodes.

Conversely, Marquet *et al.* (2013) concluded that weight cycling had no particular effect on post-career BMI in retired elite athletes, regardless of the dieting practices undertaken during their careers. Similar patterns of BMI change were observed in both retired athletes and the general population. The authors suggested that the higher levels of physical activity maintained by former athletes may explain their relatively stable body mass after retirement, despite frequent engagement in weight cycling. Comparable findings were reported by Nitzke *et al.* (1992) in a sample of 60 former collegiate wrestlers, where no significant differences were observed in body mass, physical activity, current dieting rates, or incidence of chronic disease between former wrestlers and non-athletes. However, the relatively small sample size and the focus on non-elite athletes represent important limitations in the generalization of these results.

From the evidence presented, the following conclusions can be drawn: (a) the effects of weight cycling on human health, dietary habits, and lifestyle remain insufficiently clear and under explored; (b) athletes represent a specific population

with distinct anthropological characteristics compared to non-athletes, obese individuals, and particularly rodents, thus highlighting the need for further research specifically in this group; and (c) weight cycling practices in judo differ, to some extent, from those in other combat sports due to the specific rules of the sport, and even more so from those in non-athlete populations. Therefore, the effects of weight cycling on health-related parameters in judo athletes may differ from those observed in other subpopulations. Accordingly, we conducted a study with the primary aim of examining the associations between the use of RWL methods during the sporting careers of former judo athletes and their post-career dietary habits, physical activity, and health status. The central hypothesis was that judo athletes who practiced more extreme RWL methods would demonstrate poorer health status, dietary habits, and physical activity levels after their sporting careers.

PRELIMINARY STUDY

Sample of Participants

The study sample consisted of 307 former judokas, of whom:

- 252 were male and 55 female;
- 164 competed in lightweight categories (60 kg, 66 kg, 73 kg for males; 48 kg, 52 kg, 57 kg for females), while 143 competed in heavier categories (81 kg, 90 kg, 100 kg for males; 63 kg, 70 kg, 78 kg for females);
- 237 reported practicing RWL during their careers, while 70 did not;

With respect to competitive success, 189 participants (62%) had won medals at national and international competitions (22 of whom were at continental or world championships and/or the Olympic Games), while 118 (38%) did not achieve notable competitive results. Former judo athletes who had competed in the super heavyweight category were excluded from the analyses.

Variables

For the purposes of this study, the Combat Sports Post-Career Health Questionnaire (CSPCHQ) was employed in four languages (English, Portuguese, Croatian, Spanish). Its metric properties were previously established in the study by Krstulović et al. (2023).

Data Collection and Management

This research employed a convenience sampling technique. Data was collected using an online survey tool. E-mail addresses were obtained through national judo associations and the authors' personal contacts. Participants from eight different countries were invited to complete the questionnaire, which was distributed by e-mail. Questionnaire responses were verified and entered into a spreadsheet, which was subsequently exported to the Statistical Package for the Social Sciences (SPSS, version 26.0) for further analysis, including the coding of categorical variables.

Statistical analysis

Group differences between former judo athletes with and without RWL history were tested with ANCOVAs, adjusting for age and sex. Separate ANCOVAs were also conducted for males and females to explore sex-specific effects. Effect sizes were reported using partial eta squared (ηp^2), with values of 0.01, 0.06, and 0.14 considered small, medium, and large effects, respectively (Cohen, 1988). To examine long-term predictors, multiple regression models included RWL history, years since retirement, age, and sex. Continuous variables were mean-centered. Significance was set at $p < 0.05$. Data was analyzed using SPSS 26.0.

OVERVIEW OF RESULTS

Table 1. Differences between judo athletes who practiced rapid weight loss methods and those who did not in variables assessing health status, dietary habits, and physical activity.

variables	PA	AC	FQ	DH	DC	HEALTH
RWL (n = 237)	39.48 (2.23)*	3.18 (0.21)	5.65 (0.24)*	2.98 (0.08)	2.04 (0.05)	3.81 (0.25)*
Non-RWL (n = 70)	31.76 (3.38)	2.79 (0.32)	4.64 (0.36)	3.07 (0.11)	1.88 (0.08)	3.00 (0.38)

Legend: Data presented as mean (standard error); RWL – participants who practiced rapid weight loss (RWL) during their careers; Non RWL – participants who did not practice RWL during their careers; PA – physical activity; AC – alcohol consumption; FQ – quality of consumed food; DH – dietary habits; DC – dietary self-control; HEALTH – health status, * significantly different from non RWL at $p < 0.05$.

Table 2. The impact of applied rapid weight loss methods on health status, dietary habits, and physical activity variables with respect to the time elapsed since the last RWL.

variables	PA	AC	FQ	DH	DC	HEALTH
RWL score (B)	-0.029	0.002	0.008	-0.003	0.002	0.015*

Legend: PA – physical activity; AC – alcohol consumption; FQ – quality of consumed food; DH – dietary habits; DC – dietary self-control; HEALTH – health status; B – unstandardized beta coefficient, * $p < 0.05$

Table 3. Differences between former male and female judo athletes in variables assessing health status, dietary habits, and physical activity.

variables	PA	AC	FQ	DH	DC	HEALTH
Males (n = 198)	40.35 (1.97)	3.59 (0.19)	5.74 (0.21)	2.90 (0.67)	2.27 (0.05)*	3.62 (0.23)
Females (n = 39)	38.63 (4.53)	2.98 (0.43)	5.62 (0.48)	3.05 (0.15)	1.76 (0.11)	3.84 (0.52)

Legend: Data presented as mean (standard error); PA – physical activity; AC – alcohol consuming; FQ – quality of consumed food; DH – dietary habits; DC – dietary self-control; HEALTH – health status, * significantly different from females at $p < 0.001$.

Based on the findings of this study, the following conclusions can be drawn: Former judo athletes who did not practice RWL methods exhibited significantly better health status ($F = 3.91$, $\eta p^2 = 0.013$) and higher quality of dietary ($F = 6.65$, $\eta p^2 = 0.021$), but lower levels of physical activity ($F = 4.45$, $\eta p^2 = 0.014$) compared to those who engaged in RWL during their careers. Furthermore, among judo athletes who practiced more extreme RWL methods, health status deteriorated more substantially over time, and dietary control was significantly poorer compared to those who used less extreme methods ($R^2 = 0.01$, $F = 4.99$). No significant sex differences were found in the application of RWL methods ($F = 0.10$, $p = 0.75$); however, former male judo athletes demonstrated significantly poorer dietary self-control ($F = 19.31$, $\eta p^2 = 0.076$) compared to their female counterparts. Finally, no significant differences in the use of RWL methods were observed between elite and non-elite former judo athletes ($p = 0.52$).

Previous studies have generally emphasized the acute negative effects of RWL on health status, dietary habits, and lifestyle parameters (Artoli et al., 2010, 2016; Green et al., 2007). The present findings confirm a potential long-term negative impact of RWL, particularly on health status but also on certain dietary behaviors of former judo athletes, thereby supporting the central hypothesis.

This was especially evident among athletes who, during their sporting careers, resorted to extreme RWL methods such as the use of laxatives, diuretics, diet pills, and/or self-induced vomiting. These results are concerning, as they indicate the need to educate both coaches and athletes on this issue, as well as to reconsider weigh-in regulations to reduce the use of harmful practices.

Future research should aim to include athletes from other sports in which RWL is commonly practiced and employ medical diagnostic procedures to obtain more objective indicators of participants' health status.

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HEALTH IMPLICATIONS OF WEIGHT CYCLING IN JUDOKAS

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ABSTRACT

Engaging in judo offers various health benefits, though some challenges have also been identified. One of the most significant concerns is weight cycling, a prevalent practice in which athletes intentionally reduce a considerable amount of body mass before competition and rapidly regain it afterward. Negative health implications have been reported, especially following rapid weight loss, while it is not clear whether they can be reversed following weight gain. This weight loss behaviour increases the risk of low energy availability and associated symptoms of Relative Energy Deficiency in Sport, compromising both physiological and psychological health. Implementing weight loss strategies in female judoka requires careful consideration to protect health and prevent negative outcomes. Prioritizing safe weight management and education for athletes, coaches, and support staff is essential to minimize the negative effects of low energy availability and repeated weight fluctuations while protecting long-term health and performance.

Keywords: *weight loss, low energy availability, physiological, psychological, menstrual cycle, eating disorders, female, combat sports*

INTRODUCTION

In judo, competitors are divided into weight categories of similar body mass to ensure fairness. The official weigh-in typically takes place in the afternoon before the competition day, and athletes must fall within the weight limits of their inscribed weight category. There is substantial literature documenting a high prevalence of weight-cutting practices among judokas in an attempt to compete in a category lower than their normal body mass (Artoli et al., 2010; Franchini et al., 2012; Stavrinou et al., 2022). It is commonly believed that losing weight to compete in a lower weight category and then rapidly regaining it before competition may provide a competitive advantage; however, evidence on this issue remains inconclusive (Martínez-Aranda et al., 2023). These fluctuations of weight cut and regain, known as weight cycling, may occur several times throughout a competitive season (Artoli et al., 2010).

Weight cycling

The percentage of weight loss among judo athletes has been reported to range from 63%-89%, excluding heavyweight competitors (Artoli et al., 2010; Brito et al., 2012; Escobar-Molina et al., 2015; Malliaropoulos et al., 2017). This weight loss behaviour has been reported among judokas worldwide, across both sexes, all age groups, and various competitive levels (Artoli et al., 2010; Berkovich et al., 2016; Escobar-Molina et al., 2015; Malliaropoulos et al., 2017). Typically, the magnitude of pre-competition weight loss is approximately 2-5% of body mass; however, reductions of 5-10% have also been documented in a considerable proportion of athletes (Artoli et al., 2010; Brito et al., 2012; Escobar-Molina et al., 2015).

Most reports indicate that judokas employ weight loss strategies up to five times per year, although a notable percentage of athletes engage in weight reduction as many as ten times or more annually (Artoli et al., 2010). Weight loss commonly begins 7-14 days before competition, with the majority of weight reduction occurring within the final week leading up to the event (Artoli et al., 2010; Berkovich et al., 2016; Brito et al., 2012). Athletes regain a substantial amount of body mass before fighting, and thus, athletes compete heavier than their official weigh-in body mass (Ceylan & Balci, 2023; Reale et al., 2016). However, athletes are not allowed to weigh more than 5% above their weight category at the random weigh-in conducted the morning of the competition.

Long-term and rapid weight loss (RWL) practices have been implemented by athletes in order to lose weight before competition (Stavrinou et al., 2022). There is a wide range of RWL strategies commonly utilized by judo athletes, by reducing total body water, glycogen stores, and gastrointestinal tract contents over a period of hours or days (Burke et al., 2021). The combination of increasing exercise volume and restricting energy intake, aiming to modify energy stores, appears to be the most frequent RWL method used by judokas (Artoli et al., 2010; Berkovich et al., 2016; Brito et al.,

2012; Escobar-Molina et al., 2015; Malliaropoulos et al., 2017). Another popular RWL method is body water manipulation through fluid restriction and passive and/or active sweating (Burke et al., 2021). Coaches are considered to be the most influential figures in losing weight (Berkovich et al., 2016; Do Nascimento et al., 2020).

Health consequences of weight cycling

Several adverse consequences associated with weight loss have been reported in the scientific literature. An increase in muscle damage markers has been observed following a combination of dietary restriction and intense exercise training for weight reduction, suggesting impaired muscular function and increased susceptibility of muscle tissue to injury (Roklicer et al., 2020; Umeda et al., 2004). Indeed, it has been suggested that RWL of $\geq 5\%$ of a judoka's body mass can place the athlete at a higher risk of injury compared with athletes who do not lose weight despite having time to recover during the evening before the competition (Green et al., 2007). Studies suggest that following weight loss in judokas, the immune system is compromised and hence, resistance to infection is decreased (Hiraoka et al., 2019; Suzuki et al., 2003). Also, impaired erythropoiesis and hormonal imbalances, such as reduction in testosterone and triiodothyronine (T₃) concentrations following food and fluid restriction, have been reported to be induced by RWL (Degoutte et al., 2006; Reljic et al., 2016). The manipulation of body water via sweating (*active and/or passive*) in combination with fluid restriction can lead to dehydration, which may cause, among others, increased cardiovascular and heat strain, and acute kidney damage (Lakicevic et al., 2021; Watanabe et al., 2020). Besides physiological implications, RWL has been associated with changes in mood states such as increased tension, anger, and fatigue, and reduced vigor (Degoutte et al., 2006; Filaire et al., 2001).

It is still not clear whether these acute negative health effects are transient and reversible following the weight gain, since very few studies are available. With subsequent weight regain, it seems that the hormone imbalance can be reversed (Reljic et al., 2016), while a decrease in bone resorption, favouring bone formation instead of bone loss, has also been found (Prouteau et al., 2006). In contrast, the short-term effects of RWL, such as a reduced metabolic rate and alterations to insulin and leptin levels, may precede the more severe metabolic disturbances that arise during weight regain, such as insulin resistance (Lebron et al., 2024). Haemoglobin mass may remain at a lower level after a post-competition period compared with the baseline values (Reljic et al., 2016). Recent research has demonstrated that even following 15h of recovery between the official weigh-in and competition, judokas were still in a dehydrated state, thus at risk of impaired health status and performance (Ceylan & Balci, 2023).

Furthermore, the long-term effects of repeated weight cycling during an athlete's competitive years remain unclear, particularly regarding health outcomes after retirement. Although definitive support is not currently available, repeated weight cycling and associated metabolic changes appear to contribute to obesity, metabolic syndrome, or other metabolic dysfunctions over time (Lebron et al., 2024; Maksimovic et al., 2024). Nevertheless, the long-term health effects of weight cycling require further research, while the consequences during the post-athletic career period are still insufficiently explored. Healthy weight control is essential and should be guided by evidence-based strategies for safe weight management (Poccecco et al., 2024). Practical recommendations have been published to assist athletes, coaches, and support staff in implementing these strategies effectively (Ricci et al., 2025; Stavrinou et al., 2022).

Low energy availability and relative energy deficiency in sport

Low energy availability (LEA) refers to any mismatch between dietary energy intake and energy expended in exercise, leaving inadequate energy to support the functions required by the body to maintain optimal health and performance (Mountjoy et al., 2023). The exposure to problematic (*prolonged and/or severe*) LEA can cause a syndrome of impaired physiological and/or psychological functioning called Relative Energy Deficiency in Sport (REDs). The detrimental outcomes of REDs include, among others, decreases in energy metabolism, reproductive function, musculoskeletal health, immunity, glycogen synthesis, and cardiovascular and hematological health, which can all individually and synergistically lead to impaired well-being, increased injury risk, and decreased sports performance (Mountjoy et al., 2023). Acute mild periods of LEA may trigger reversible physiological changes without adverse outcomes (*adaptable LEA*). On the other hand, according to a recent narrative review, even short-term severe LEA can trigger energy-conserving responses affecting multiple physiological systems, including endocrine, skeletal muscle, immune, and cognitive functions (Jeppesen et al., 2025).

It is plausible to assume that since the majority of judoka frequently engage in severe body mass reduction may have a short-term exposure to LEA, and be particularly susceptible to REDs. However, it is still unknown whether and when this

LEA exposure is adaptable or problematic, leading to REDs consequences. Furthermore, if it is taken into account that judokas undergo weight cycling multiple times per year, it is possible to believe that the detrimental effects of repeated short-term severe LEA are not reversed, progressing thus to long-term problematic LEA, which can result in the inability to sustain optimal physiological function for exercise performance and health. Nevertheless, limited research exists related to the prevalence of LEA or REDs in judo athletes, leaving a great research gap.

Female judoka

The female judokas have been largely understudied compared to other female athletes or their male counterparts, even though they are facing unique challenges during their sport engagement. Regarding weight cycling, according to the majority of research, there is no major difference between the sexes in terms of weight loss severity or prevalence (Artoli et al., 2010; Malliaropoulos et al., 2017; Štangar et al., 2022). However, female athletes were significantly underrepresented in studies examining the prevalence of RWL among athletes of both sexes; typically comprising around 30% of the total athlete sample (Artoli et al., 2010; Ceylan & Balci, 2023; Malliaropoulos et al., 2017), while some studies have managed to engage more female judokas (Štangar et al., 2022).

Weight loss in female athletes may require additional considerations. The existing literature indicates that sex differences may exist in the threshold, time course, and magnitude of the effects of LEA on physiological parameters, with females being potentially more sensitive to reductions in energy availability (Jeppesen et al., 2025; Mountjoy et al., 2023). A recent study showed that among female athletes of combat sports (including judokas), 45% of athletes were at increased risk of LEA, while during the competition week, all athletes exhibited LEA (Liang et al., 2025). Evidence from a meta-analysis revealed that sports requiring weight categories (e.g., judo) and emphasizing thinness/leanness had higher levels of disordered eating relative to athletes participating in other types of sports (Chapa et al., 2022). Accordingly, twenty-five percent of female judo athletes were found to be at risk of eating disorders (Rouveix et al., 2007), while thirty-three percent of female combat sports athletes reported having either a history or current symptoms of eating disorders (Mathisen et al., 2022). Another recent study revealed that approximately four out of five female combat sports competitors display moderate to very high indications of disordered eating, even at seven days post-competition (Doherty et al., 2024). Interestingly, in a study performed by elite judo athletes from different age and gender groups, it was found that female judokas were more concerned about their diets, presented higher anxiety, scored higher in the emotion scale, and had more eating disorder symptomatology compared to males, especially in cadet and junior age categories (Escobar-Molina et al., 2015).

According to the literature, female athletes are more likely than the general population to experience irregular menstruation (Gimunová et al., 2022; Taim et al., 2023), with the weight-sensitive sports reporting the highest incidences (Gimunová et al., 2022). Considering the above, judokas who often deal with weight reduction are probably more likely to experience menstrual irregularities. Accordingly, prior research on female judo athletes revealed that 58% experienced menstrual dysfunction (secondary amenorrhea and oligomenorrhea) (Rouveix et al., 2007), while 22% of adolescent female judokas were found to experience amenorrhea for a year (Boisseau et al., 2005). Nonetheless, current evidence on the effects of weight cycling and LEA in female judoka remains limited, highlighting the need for further research.

CONCLUSIONS

Despite strong evidence demonstrating the negative health consequences of weight cycling, this practice remains widespread in judo. To protect the health and long-term well-being of judokas, it is essential to minimize the frequency and extent of weight manipulation. Weight management strategies in female athletes should be approached cautiously, taking into account the associated physiological risks. Education of athletes, coaches, and support staff on the risks of severe short-term/prolonged periods of LEA and repeated weight fluctuations is critical. Sporting environments should prioritize health and ensure safe weight management practices, thereby preventing potential adverse effects while supporting athletic performance.

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Usability of an adapted tatami for judo athletes with visual impairments: A preliminary study

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ABSTRACT

Judo for athletes with visual impairments has evolved to include adaptations that ensure accessibility, safety, and fair competition, including grip-based match starts and revised classification systems (*J1 and J2*) based on visual acuity and field. Despite these measures, training and competition environments may still pose perceptual and functional challenges. This preliminary cross-sectional study evaluated the usability of an adapted tatami surface incorporating tactile and contrasting color cues, using the System Usability Scale (*SUS*). Thirty participants, including 22 athletes and 8 para-judo coaches, assessed the adaptations. Results indicated a mean *SUS* score of 77.5 for all respondents and coaches, classified as “Good,” while athletes rated usability as 95.0, classified as “Excellent.” These findings suggest that the adaptations are highly functional and satisfactory, enhancing spatial orientation and supporting neuromuscular performance. From an accessibility perspective, implementing such adaptations in competitive settings, alongside tactile markings and verbal guidance, can promote inclusive participation, equitable opportunities, and improved engagement for athletes with visual impairments.

Key Words: Para Judo, Tactile Cues, Color Contrast, Inclusive Design, Accessibility

INTRODUCTION

Judo for athletes with visual impairment was first introduced at the 1988 Seoul Paralympic Games for men and later, in 2004, for women at the Athens Paralympic Games [1]. The rules are largely identical to those of Olympic judo, with one key difference: matches begin with both athletes establishing grips on each other's jackets (*judogi*) (Figure 1) [1]. This procedure is repeated whenever the combat is interrupted [2,3,4], ensuring that athletes maintain physical contact throughout the match. In contrast, Olympic judo begins without contact, requiring competitors to first engage and establish grips before initiating attacks [5].



Figure 1. Start of combat in judo for athletes with visual impairment

Recently, a new visual impairment classification code was introduced for Paralympic judo, redefining how athletes are categorized according to their level of visual function [1]. Under this updated system, competitors are divided into two groups, J1 and J2, based on standardized visual acuity and visual field assessments. The J1 class includes athletes with a binocular visual acuity of less than or equal to LogMAR (*logarithm of the minimum angle of resolution*) 2.6, indicating very limited or no light perception. The J2 class comprises athletes with a binocular visual acuity ranging from LogMAR 1.3 to 2.5, or a binocular visual field restricted to 60° or less in diameter [1,3]. This new classification aims to enhance fairness and clarity in competition by aligning athletes with comparable levels of visual ability [3]. Additionally, to address the challenge of small participant numbers across divisions, the International Blind Sports Federation reorganized the traditional seven weight categories into four broader groups, ensuring more balanced and competitive events [1].

Judo for athletes with visual impairment has been one of the Para sports in which scientific research has played a crucial role in promoting equity within the Paralympic movement, particularly regarding fairness between classification groups [1]. Beyond issues of classification, however, an important consideration concerns athletes' adaptation to the competitive environment. Because of the specific needs associated with visual impairment, judo matches rely on additional support from referees and coaches. Referees play an active role in ensuring proper positioning and orientation of athletes during matches [6], especially after interruptions, while coaches often assist athletes in navigating to and from the competition area [6]. These procedures, although necessary for accessibility and safety, highlight the ongoing challenges of achieving full autonomy and equal competitive conditions in Para judo [7].

In the context of adapted sports, adjusting training environments is essential for optimizing performance and ensuring safety among athletes with disabilities [7]. In judo, athletes with visual impairments depend heavily on tactile and proprioceptive cues due to limited or absent visual input [8,9]. However, traditional tatami surfaces may not fully support their unique needs for spatial orientation and movement, particularly during combat-simulated or dynamic actions [1]. To overcome these limitations, modifying the tatami surface may enhance athletes' perception, stability, and overall performance [8,9]. Given that judo performance is closely tied to neuromuscular control, strength, and power [10], it is crucial to evaluate the functional usability of such adaptations. In this context, the present preliminary study aimed to assess the usability of an adapted tatami surface using the System Usability Scale (*SUS*), with a view toward its potential application in adapted judo settings.

METHODS

Design

This preliminary cross-sectional study aimed to evaluate the usability of this adapted tatami surface using the SUS. Initially, the SUS questionnaire was administered both in person and online to professionals working with judo practitioners/athletes with visual impairment. Prior to data collection, the research team contacted these professionals to explain the study's objectives, outline potential benefits for athletes and coaches, and obtain authorization for conducting the assessments. The instrument was answered, taking into account the tatami adaptations shown in *Figure 1*.

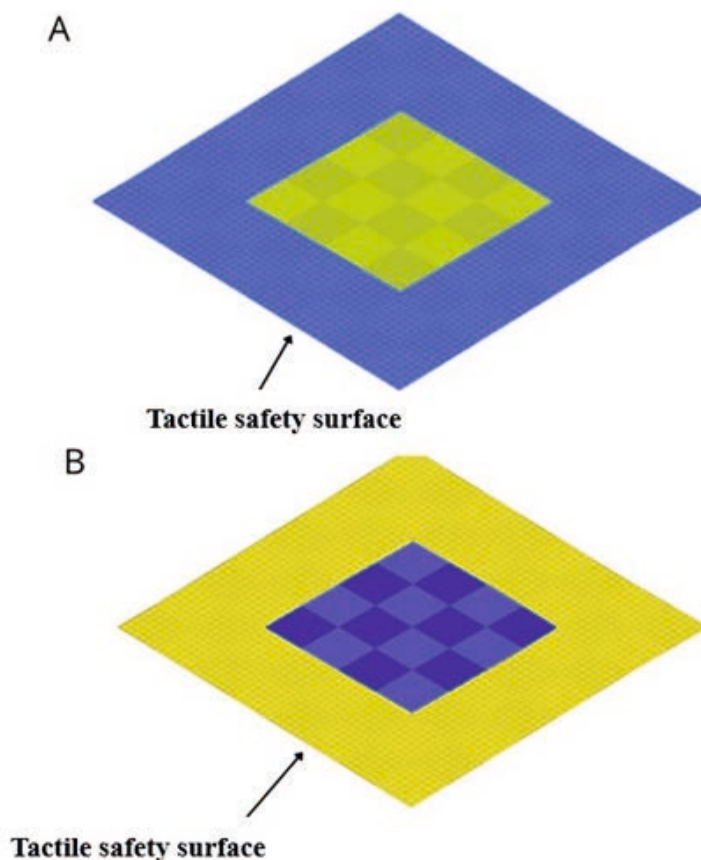


Figure 1. Competition area based on contrasting colours with ball-shaped safety markers; (A) blue safety area and yellow central area and (B) yellow safety area and blue central area.

PARTICIPANTS

Thirty judo experts participated in this preliminary study, including para-judo coaches ($n = 8$; mean age = 46.5 ± 16 years; coaching experience = 26 ± 17 years) and athletes ($n = 22$; mean age = 22 ± 8 years; training experience = 11 ± 7 years). All coaches were actively involved in training judo athletes with visual impairment, while the participating athletes also regularly trained alongside peers with visual impairment.

PROCEDURES

All participants completed the SUS questionnaire, evaluating the tactile adaptation of the tatami surface considering contrasting colors (blue and yellow). For the SUS scale, valid responses were analyzed, and data were processed using a 5-point Likert scale. For odd-numbered items, 1 is subtracted from the participant's response, while for even-numbered items, the response is subtracted from 5. The resulting values are then summed and multiplied by 2.5, yielding a final score ranging from 0 to 100. Higher scores indicate better usability, and a score of 68 or above is considered above average [11].

Statistical Analysis

Data were analyzed using descriptive and inferential statistics. Descriptive analysis included means, standard deviations, and qualitative classifications of the SUS scores according to established benchmarks.

RESULTS

In the Table 1, shows the results of the System Usability Scale across all participant groups. When considering all respondents together, the mean SUS score was 77.5, which corresponds to a “Good” usability classification, describing the system as a functional and reliable product. Coaches reported an identical mean score of 77.5, also classified as “Good”, reflecting similar perceptions of functionality and reliability. In contrast, athletes rated the system more favorably, with a mean SUS score of 95.0, corresponding to an “Excellent” classification and described qualitatively as a highly satisfactory product.

Table 1. Usability results of adapted tatami with tactile stimulus considering all groups, coaches and athletes

Groups	SUS Score*	Classification ¹	Qualitative Evaluation
All	77.5	Good	Functional and reliable product
Coaches	77.5	Good	Functional and reliable product
Athletes	95.0	Excellent	Highly satisfactory product

DISCUSSION

The results of this preliminary study demonstrated that the adapted tatami surface, featuring tactile and contrasting colour cues, was perceived as highly usable by both coaches and athletes involved in judo training with athletes with visual impairments. Particularly, Para athletes rated the usability as "excellent," suggesting that such adaptations are not only functional but also highly satisfactory from a practical standpoint [7]. These findings reinforce the importance of modifying training environments to accommodate the specific perceptual needs of judo athletes with visual impairment [7,8,9]. Given that these athletes rely heavily on non-visual cues such as proprioception, tactile feedback, and auditory information to navigate and interact within the combat space, the integration of tactile features into the tatami surface appears to offer meaningful support [8,9]. Overall, the positive usability ratings suggest that adaptations like tactile tatami surfaces could play a significant role not only in improving training quality and safety but also in supporting the neuromuscular demands of judo [7,8,9]. These results highlight the potential of inclusive design in sport-specific equipment, offering practical avenues for optimizing performance in adapted sports contexts [3,7].

From an accessibility perspective in para judo, Kons and Haegele [7] emphasize how inclusive practices can effectively promote equitable participation for athletes with visual impairments. They outline strategies to overcome accessibility challenges in competitive judo, drawing on expert insights [12]. This work deepens the understanding of judo competition dynamics by highlighting the importance of inclusivity and equal access for all athletes, regardless of visual ability, and advocates for practical improvements that create a competitive environment accommodating diverse needs, ensuring that judo remains both accessible and welcoming to athletes with visual impairments [3,4,7].

In this context, implementing these recommendations in judo competitions can significantly enhance accessibility and inclusivity by adapting rules, equipment, and competition environments to the specific needs of athletes with visual impairments [7]. Such measures can include tactile markings on the tatami, clear verbal cues from referees and coaches [6,8,9], and individualized support during matches. Moreover, promoting accessibility in competitions contributes to broader social and psychological benefits, including increased confidence, motivation, and a sense of belonging within the para sports community [7].

Finally, these findings indicate that, from an expert perspective, the adapted tatami is highly accessible to individuals with low vision and total visual impairment, and is suitable for ongoing assessment within the judo competition environment. The SUS is a well-established instrument for evaluating usability across diverse domains, and the findings underscore the value of integrating both user and expert feedback in the development of accessible tools for para judo,

a field already recognized as essential for athletes with visual impairments [13]. Furthermore, incorporating expert perspectives aligns with evidence-based classification systems in para judo [12], supporting the development of novel assessment instruments and technologies that adhere to universal design principles [7].

CONCLUSION

This preliminary study demonstrated that the adapted tatami with tactile and color-contrast cues was rated as highly usable by both coaches and athletes involved in judo for athletes with visual impairments. The findings support the potential of such adaptations to enhance spatial perception, training quality, and safety, reinforcing the importance of inclusive design in adapted sports environments.

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Assessing Dietary Knowledge in Trained Male and Female Judoka

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ABSTRACT

Good general and sports nutrition knowledge in athletes is crucial for making appropriate dietary choices for training and competition as well as attaining a desired weight category. The assessment of nutrition knowledge to date in judoka is very limited. The aim of this study was to assess the nutrition knowledge (*both general and sport-specific*) in trained male and female judo athletes in the United Kingdom. 65 (*males N=33 & females N= 32*) trained, non-elite judoka completed a validated nutrition knowledge questionnaire (PEAKS-NQ). Participants answered the questionnaire containing 3-sections; data on demographic characteristics, general nutrition knowledge, and sports nutrition knowledge via the online platform Jisc. Each participant was given 3 scores shown as percentages; overall nutrition knowledge score, general nutrition knowledge score, and sports nutrition knowledge score. Results showed that overall, the median score for nutrition knowledge was 56% (42 points, IQR=14.50). General nutrition scores were higher than sports nutrition knowledge scores (61% vs 53.6%). No statistical difference was found between males and females in nutrition knowledge. Specific knowledge gaps were identified in relation to post-exercise recovery nutrition, protein, and hydration recommendations. These findings highlight the importance of developing nutrition education programmes to support judoka, to reduce unsafe rapid weight loss practices while enhancing performance and athlete well-being.

Keywords; *Judoka, Nutrition Knowledge, PEAKS-NQ, Rapid weight loss*

INTRODUCTION

Nutrition knowledge is a cornerstone for athletic performance, particularly in high-stakes sports like judo. Judo is a high-intensity intermittent combat sport which requires technical skills as well as strength and speed to execute throwing techniques (Franchini *et al.*, 2011). The aerobic and anaerobic energy systems are used during this form of exercise (Artoli *et al.*, 2012 & Carmo *et al.*, 2021). Engagement in this physical activity requires a lot of energy in the form of adenosine triphosphate (ATP), which is derived from the metabolic breakdown of macronutrients obtained from food (Alberts, 2002). Therefore, adequate intakes of macronutrients and accompanying micronutrients, strategic fuelling and hydration are all crucial to support physiological demands, optimise energy availability and promote training adaptation (Amawi *et al.*, 2024).

A key characterisation of judo and one which adds further complexity to fuelling, is the use of rapid weight loss (RWL) methods (Danilo *et al.*, 2024). As a weight-category sport, judoka need to 'make weight' to compete, this means that athletes will lose anywhere between 2-10% of their body weight 2-3 days before competition (Danilo *et al.*, 2024). To achieve this rapid weight loss (RWL) radical strategies are often adopted (Lakicevic *et al.*, 2020). The prevalence of RWL in judo is high, with one study looking at 138 elite-level judoka, finding that 96% engaged in these strategies and that those who started RWL practices before the age of 16 (38%) were ranked lower on the world ranking list and reported more negative consequences of RWL than those who started after the age of 16 years old (Štangar *et al.*, 2022). Another study found that out of 256 judokas 84% partook in RWL strategies with a mean loss of 2.4kg (Maffulli, 2017). These methods ranging from fluid restriction and glycogen depletion to sauna use and fasting (Poccecco *et al.*, 2024), are often performed without expert guidance, demonstrating a reliance on anecdotal advice over scientific principles that can be attributed to gaps in nutritional knowledge (Poccecco *et al.*, 2024). The risks of unhealthy weight reduction methods affecting long-term health and short-term performance is high (Pettersson *et al.*, 2012; Poccecco *et al.*, 2024). One such risk is Low Energy Availability (LEA) which occurs when an athletes' dietary intake is insufficient to cover the energy expended during exercise, leaving inadequate energy for the body to maintain optimal health and performance (Marzuki *et al.*, 2024). When the state of energy expenditure becomes chronic, it impairs essential bodily functions, leading to Relative Energy Deficiency in sport (RED-s). The negative consequences of RED-s are numerous and include; nutrient deficiencies,

persistent fatigue, compromised immune function and increased risk of injury, predominantly stress fractures (*Cansu Tektunalı Akman et al., 2024; Amin Hasanpouri et al., 2023*). Athletes must consistently make food choices aligned with their goals, for these reasons. These choices are heavily influenced by their level of nutritional knowledge. (*Birkenhead & Slater, 2015; Amawi et al., 2024*).

While knowledge alone is not sufficient to drive behaviour change (*Arlinghaus & Johnston, 2017*) it is a critical step (*Kelly & Barker, 2016*). Models such as the Capability, Opportunity, Motivation – Behaviour (COM-B) framework proposes three necessary components to be present for behaviour change to occur (*Michie et al., 2011*). Capability refers to an individual's knowledge, skills, and ability to engage in a behaviour. Opportunity in the context of this model refers to the external environment or factors that make doing the behaviour possible or not. Motivation refers to an individual's desires and internal processes which influence decision-making such as values and desires (*Michie et al., 2011*). Based on this gold-standard framework to develop effective solutions, baseline nutrition knowledge needs to be assessed within this population as this could be one of the barriers or facilitators to behaviour change (*Michie et al., 2011*).

The study aims to provide foundational data that will not only justify the need for nutrition education but also highlight specific gaps to guide the creation of evidence-based interventions tailored to the needs of judo athletes. The primary aim of this study is to quantify the general and sports nutrition knowledge of UK judo athletes using a validated questionnaire; Platform for Evaluating Athlete Knowledge in Sports Nutrition Questionnaire. The secondary aim is to identify whether demographic factors such as gender, influence nutrition knowledge scores of these athletes.

MATERIALS AND METHODS

This observational cross-sectional descriptive study was approved by the St. Mary's University Ethics committee (*SMU_ETHICS_2024-25_25_10*). Participants completed an online questionnaire using JISC software.

The survey: Platform to Evaluate Athlete Knowledge Sports Nutrition Questionnaire

The Platform to Evaluate Athlete Knowledge Sports Nutrition Questionnaire (*PEAKS-NQ*) was selected for its robust validation, contemporary design, and specific application to UK populations. (*Edmonds et al., 2023*). The internal consistency was assessed using Cronbach's alpha coefficient and scored 0.83 for the UK-I version (*Edmonds et al., 2023*).

The 55-question survey was divided into three sections; Introductory which captured demographic and training data. General nutrition assessing foundational knowledge (34 points) and sports nutrition which focused on performance-related topics like recovery, fuelling and hydration (41 points). The total possible score was 75 points. For questions with multiple correct answers, participants received one point per correct answer and were deducted one point per incorrect answer to discourage selection of all available options (*Tam et al., 2020*).

Participants and data collection

Recruitment occurred online via social media and through direct contact with judo clubs in the Greater London area between April 1st and September 15th, 2025. Of the 78 respondents, 13 were excluded for incomplete data or not meeting the inclusion criteria (*membership in the British Judo Association*). The final sample consisted of N=65 participants (33 males, 32 females), ranging from novice to national-level athletes. This sample size was deemed sufficient for a descriptive study (*Kemal, 2020*). Consent was assumed upon voluntary completion of the anonymised questionnaire.

Statistical Analysis

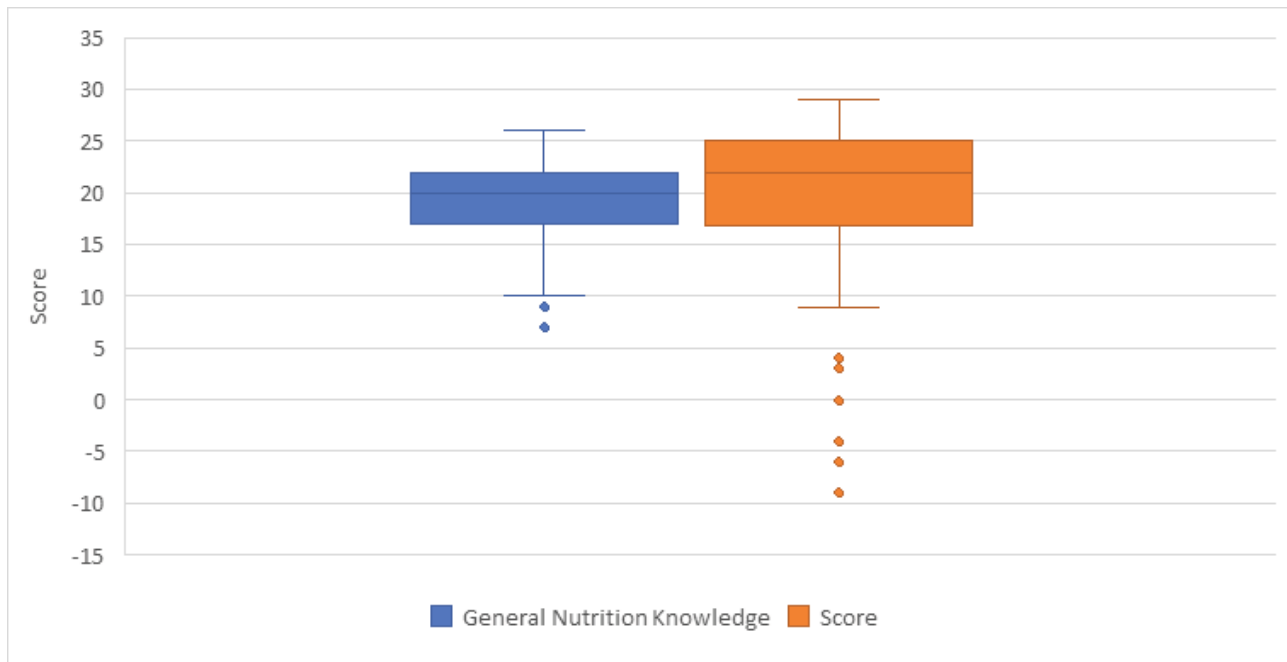
Data was coded in Microsoft Excel, and statistical analysis was performed using IBM SPSS (*version 30*). Scores for general nutrition, sports nutrition, and the combined total were calculated as percentages. A Kolmogorov-Smirnov test revealed that most data were not normally distributed. Consequently, a non-parametric approach was used for all analyses. Scores are reported as median and interquartile range (*IQR*), and a Mann-Whitney U-test was used to compare scores between genders. Statistical significance was set at $p < 0.05$.

RESULTS

The overall median combined score for all participants was 42.00 (56% *IQR*= 14.50). There was no statistically significant difference in the combined total nutrition score between female judokas (*Median* = 56%, *IQR* = 12.00) and male judokas

(Median = 54.6%, IQR = 15.50; $U = 445.50$, $p=0.279$). The median sports nutrition score and general nutrition score can be seen in the box and whisker plots below.

Fig.1. Median General Nutrition knowledge scores vs. Median Sports nutrition knowledge



General nutrition scores were not significantly different between females (Median 58.44 %, IQR = 4.75 and males (Median 56.59 %, IQR = 6.50; $U = 509.00$, $p=0.802$).

Finally, no significant difference was found for sport nutrition scores between females (Median = 51.12%, IQR = 8.75) and males (Median = 43.66%, IQR = 10.00; $U = 419.00$, $p=0.152$).

DISCUSSION

The principal finding was that UK judo athletes possess a moderate level of nutrition knowledge indicated by a median total score of 56% which suggests a significant knowledge gap. This may be due to several reasons; lack of accessibility to nutrition professionals, time constraints and priorities, athletic culture sometimes prioritises hacks as research suggests in the rapid weight loss methods (Pocecco et al., 2024).

Nutrition Knowledge Gaps

A key finding emerged between knowledge domains, with participants scoring higher on general nutrition (61%) compared to sport-specific nutrition (53%). The overall score of 56% is considerably lower than the 70.7% reported in elite Australian athletes using the same questionnaire (Tam et al., 2021), likely reflecting differences in access to professional nutrition support (Wells et al., 2020). However, the score is comparable to or slightly better than those found in other athlete populations, such as Gaelic games players and futsal players (Renard et al., 2020; Mitchell et al., 2021; Angelo et al., 2021). This suggests that while their knowledge is not uniquely low, there is substantial room for improvement, especially given the specific pressures of making weight in judo (Berkovich et al., 2016; Torres-Luque et al., 2016).

There is a substantial body of evidence that highlights the association between inadequate nutritional knowledge and suboptimal dietary behaviours (Khalidi et al., 2022; Janiczak et al., 2021). Limited awareness of fundamental concepts such as energy requirements, macronutrient and micronutrient adequacy has been linked to poor dietary choices (Scalvedi et al., 2021), low energy availability (PAI et al., 2024), and dangerous weight cutting methods (Maffulli, 2017). These behaviours not only impair performance but may also compromise health outcomes over time (Danilo et al.,

2024). Chronic energy deficiency can impair bone health, reduce muscle strength, and compromise immune function (Sale & Elliott-Sale, 2019; O'Leary et al., 2020). Key nutrients such as protein, calcium and vitamin D may delay tissue repair and recovery, increasing susceptibility to injuries (Caballero-García et al., 2021; Smith-Ryan et al., 2020). Nutrition plays a critical role in injury prevention and recovery by supporting an athlete's physical and psychological well-being and promoting effective tissue repair (Turnagöl et al., 2021).

Improved nutrition knowledge may lower injury rates, reduce dangerous weight cutting strategies amongst judokas and ultimately reduce societal healthcare burden. Participating in sports especially at a high level carries a risk of injury, a study done on 7,870 athletes, 90% of them declared having experienced at least one injury throughout their sporting careers (Edouard et al., 2024). In combat sports, such as judo, this risk increases significantly, about one-third of injuries result in more than 7 days absence from competition and training which over a calendar year can amount to a lot of absence (Turnagöl et al., 2021). This substantial time away can severely disrupt an athlete's progress, impacting their readiness for key events and ultimately jeopardising their chances of achieving high-level goals such as qualifying for the Olympic Games or medalling at European and World championships.

This gap highlights the need for a multi-tiered educational approach, the 'one-size-fits-all' model is inaccurate (Guest et al., 2019). A generalised approach is ineffective as it cannot account for individual variables, including an athlete's weight category, training volume, metabolic rate, and personal dietary preferences.

In contrast, practitioners and athletes understand that personalised interventions, which are tailored to these specific factors, are more likely to be successfully adhered to and integrated into an athlete's routine (Shyam et al., 2022). As the national governing body, the British Judo Association (BJA) is in an ideal position to implement such a strategy. The BJA could develop a structured framework of tailored nutrition support to promote healthy and sustainable weight management practices, ensuring they do not detrimentally affect athlete health or performance. This could be delivered through online modules integrated with coaching certifications and practical workshops on crucial topics such as 'Nutrition around weigh-ins' or 'competition fuelling strategies'.

Gender differences

The secondary aim was to investigate gender differences. Although females scored marginally higher, the difference was not statistically significant. This aligns with some research (Trakman et al., 2016) but contrasts with other studies that found female athletes to have superior nutrition knowledge (Tam et al., 2021; Spronk et al., 2015). The shared, high-pressure environment of a weight-category sport may override typical gender-based differences in health-seeking behaviours. This finding reinforces that gender is not always a reliable predictor of nutrition knowledge in athletic populations.

Strengths & Limitations

A primary strength of this study is the use of the PEAKS-NQ, a robust and culturally relevant tool that enhances the credibility of the findings and allows for meaningful future comparisons. This study provides a critical baseline for an under-researched population.

A limitation was the use of convenience sampling, which may limit the generalisability of the results (Andrade, 2021; Tyrer & Heyman, 2016). Furthermore, the study did not assess athletes' perceived nutrition knowledge. Understanding the gap between what athletes think they know and what they actually know could provide valuable insights for tailoring educational interventions, as self-efficacy is a strong driver of behaviour change (Michie et al., 2011; Scalvedi et al., 2021).

Future Directions

These findings highlight an urgent need for targeted, evidence-based nutrition education for UK judo athletes. The British Judo Association (BJA) is ideally positioned to develop a structured framework of support. This could include online modules, practical workshops on topics like competition fuelling, and resources for making weight safely. Future research should focus on developing and evaluating such interventions and exploring the link between knowledge, dietary behaviour, and performance outcomes in this population.

CONCLUSION

This is the first study to assess nutrition knowledge in UK judokas. Findings show a moderate overall knowledge with no difference between males and females. These results underscore the need for tailored, evidence-based nutrition education within judo to reduce unsafe rapid weight loss practices while enhancing performance and athlete well-being. Assessing nutrition knowledge not only informs practice but also provides a quantitative means of evaluating education interventions. This research provides the foundational evidence needed to develop effective, judo-specific nutrition programmes.

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Body mass change and hydration status of child judokas during national championship: A descriptive study

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ABSTRACT

This descriptive study examined body mass and hydration status in child judokas ($n=10$; aged 10–12 years) across a national championship. Hydration was assessed via urine specific gravity (USG) and urine colour (UC) at three time points: one week pre-competition ($T1$), at the official weigh-in ($T2$), and one week post-competition ($T3$). While no significant change in body mass was observed across time points ($p=0.06$), a significant change in USG was found ($p=0.01$). Post-hoc analysis revealed a significant increase in USG from $T1$ to $T2$ ($p=0.01$, $ES=-2.15$), indicating a state of hypohydration at weigh-in, followed by a significant decrease from $T2$ to $T3$ ($p=0.01$, $ES=1.10$). No significant differences were detected in UC ($p=0.11$). At weigh-in, all athletes were dehydrated. The findings indicate that despite stable body mass, child judokas experience significant fluctuations in hydration status, arriving at competition in a dehydrated state. This highlights a critical need for structured hydration strategies and education for young athletes and coaches to optimize performance and health.

Keywords: combat sports, dehydration, urine specific gravity, youth athletes, weight management

INTRODUCTION

Hydration status is a critical factor affecting athletic performance in combat sports such as judo, where athletes typically exert intense physical effort and experience rapid weight changes (Ceylan & Balci, 2023; Ceylan, Barley, et al., 2023). Adequate hydration is essential for maintaining physiological functions, optimizing performance, and preventing injuries (Meyer et al., 2016). Dehydration, defined as a deficiency in total body water, has been shown to have various adverse effects on athletic performance. Dehydration can impair cognitive functions (Wittbrodt & Millard-Stafford, 2018), reduce strength, and decrease endurance, all of which are critical for optimal performance in judo (Ceylan et al., 2022). Furthermore, hypohydration can increase heart rate, raise body temperature, and impair thermoregulation, thereby further increasing the physical load on athletes (Cheuvront & Kenefick, 2014). These effects are particularly concerning for judokas, who often resort to rapid weight loss to compete in a particular weight category and are therefore more prone to hypohydration (Artoli et al., 2010; Barley et al., 2019).

The literature includes many studies related to the hydration status of judokas before and after competitions, and during training (Ceylan, 2021; Ceylan et al., 2020; Ceylan & Santos, 2020; Ceylan, Taşcan, et al., 2023). However, the participants in those studies were senior, elite athletes. To the best of our knowledge, there are no studies in the literature examining hydration status of child judokas during the competition period. Therefore, the aim of this study was to determine the hydration status and body mass change of child judokas before, during, and after competition.

MATERIALS AND METHODS

Participants

Ten judo athletes aged 10–12 participated in the study. The criteria for the athletes' participation were as follows: possessing at least a green belt, having practiced judo for 3 years, having competed in official tournaments for 2 years, and having no injuries that would prevent participation in training for the last 6 months.

Anthropometric Measurements

The anthropometric measurements of the athletes included height and body weight. Upon arrival at the training hall, their height was measured with a precision of 0.1 cm, followed by the determination of their body weight using a scale.

Hydration Status

The hydration status of the athletes was assessed one week before the competition, before training (*T1*), before the official weigh-in at the competition (*T2*), and one week after the competition, before training (*T3*). The athletes were instructed on how to provide their urine samples prior to collection, and sterile urine containers were distributed. They were then asked to provide a mid-stream urine sample (Zubac *et al.*, 2016) before training, place it in the sterile container labeled with their name, and leave it in the sample collection area. The urine samples were analyzed using a refractometer.

STATISTICS

Statistical analysis was carried out using JASP software (version 0.19.3.0, The Netherlands). Variables' normality was checked with Shapiro Wilk test and skewness and kurtosis coefficients. Data was presented as mean and standard deviation and 95% confidence intervals (*CI*) was also provided. In order to see the change in body mass, USG and UC at different time points, a repeated measures ANOVA was used. In case of significant difference, a post-hoc analysis with Holm correction was applied. The significance level was set at $p < 0.05$. Effect sizes were reported as Cohen's *d* for post hoc comparisons, eta squared (η^2) for ANOVA.

RESULTS

The change in body mass among a week before, at the official weigh-in and one-week post competition was not significant ($F_{2,16} = 3.48$, $p = 0.06$, $\eta^2 = 0.30$; *ES = Large*). Athletes' body mass change can be seen in Table 1.

Table 1. Change and 95% CI of the athletes' body mass across measurement times

Variables	Mean $\pm$ SD	95% CI
T1	43.31 $\pm$ 9.10	36.31-50.31
T2	42.33 $\pm$ 9.28	35.20-49.46
T3	42.61 $\pm$ 8.77	42.61-49.35

Athletes hydration status via USG significantly changed across measurement times ($F_{1,26,10.10} = 9.83$, $p = 0.01$, $\eta^2 = 0.55$; *ES = Large*). Athletes' USG values significantly increased from T1 to T2 ($p = 0.01$, $ES = -2.15$ [*Large*]) and decreased from T2 to T3 ($p = 0.01$, $ES = 1.10$ [*Large*]). Athletes USG values can be seen in Table 2.

Table 2. Change and 95% CI of the athletes' USG values across measurement times

Variables	Mean $\pm$ SD	95% CI
USGT1	1.019 $\pm$ 0.005	1.015-1.023
USGT2	1.026 $\pm$ 0.003	1.024-1.028
USGT3	1.022 $\pm$ 0.001	1.021-1.023

Athletes' UC did not change significantly across the measurement times ($F_{1,24,9.91} = 3.06$, $p = 0.11$, $\eta^2 = 0.28$; *ES = Large*). Athletes UC values can be seen in Table 3.

Table 3. Change and 95% CI of the athletes' UC values across measurement times

Variables	Mean $\pm$ SD	95% CI
UCT1	4.11 $\pm$ 1.36	3.06-5.16
UCT2	5.33 $\pm$ 1.00	4.57-6.10
UCT3	5.00 $\pm$ 0.71	4.46-5.54

Athletes' hydration classification revealed that 5 of the athletes were hydrated and 4 were dehydrated a week before the competition. At the weigh-in, all athletes were classified as dehydrated and they were also in a dehydrated state following almost 15-h recovery before the start of the competitions.

DISCUSSION

The aim of this study was to determine the body weight, urine specific gravity, and urine color of child judo athletes before, during, and after a competition. The study had three main findings. Firstly, no significant differences were observed in the athletes' body weight changes between the pre-competition, competition, and post-competition periods. The hydration status of the athletes showed an improvement from the pre-competition period to the time of the competition. While hydration status during the competition was high, post-competition hydration status was found to be lower. No differences were observed in the athletes' urine color between measurements.

In the current study, no significant changes were observed in body weight between measurements. Rivera-Brown and De Félix-Dávila (2012), in their study examining the hydration status and body weight of adolescent athletes before and after training in hot conditions, observed a loss of approximately 2% in body weight. The reason why athletes lost that much body mass was environmental condition athletes were exposed to. In another study, Ceylan, Barley, et al. (2023) monitored the body weight and hydration status of elite athletes during a high-level competition and observed that the athletes lost approximately 6% of their body mass from one week before the competition to the official weigh-in. They also observed an approximate 4% increase in body weight 24 hours after the competition. This is likely because elite athletes competing in events like qualification for the Olympics cannot change weight classes and must therefore make weight for their specific category (Ceylan, Barley, et al., 2023). In a study examining the body weight, hydration status, and fluid intake of U15 judo athletes before and after a training session, differences were found between pre- and post-training body weight (Ceylan & Santos, 2020). This is a common and expected outcome following a training session in judo due to the cotton uniforms (*judo gi*) worn by the athletes.

In the current study, USG values showed an increase from one week before the competition until the weigh-in day, while a decrease was observed from the weigh-in until one week after the competition. Similarly, Rivera-Brown and De Félix-Dávila (2012) observed that the athletes' hydration status worsened (*USG increased*) after training. It was noted that athletes were unable to fully replenish the fluids lost during training after the training session. In fact, it was recorded that some athletes failed to fully restore their hydration status even by the time of the next day's training session (Rivera-Brown & De Félix-Dávila, 2012). Ceylan, Barley, et al. (2023) stated that USG values increased from one week before the competition until the official weigh-in. Values taken at the weigh-in were found to be lower 24 hours after the competition. These values indicate that some of the athletes rehydrated within 24 hours after weighing in. In a study by Ceylan et al. (2020), 81% of participants were dehydrated before training, and 77% were dehydrated after training. This demonstrates that while some athletes managed to regulate their hydration levels by consuming sufficient fluids during training, others remained dehydrated due to inadequate fluid intake.

In the current study, no differences were observed in the athletes' UC measurements. However, Rivera-Brown and De Félix-Dávila (2012) observed a difference in UC between pre- and post-training. The reason for this was likely the weight loss and elevated USG levels experienced by the athletes after training. Ceylan, Barley, et al. (2023) in their studies observed UC values to be at their highest level at the competition weigh-in. An improvement in UC values was observed after the weigh-in.

In conclusion, this study provides valuable insight into the dynamic nature of hydration status across a competition period in child judo athletes. The key finding that body weight remained stable suggests that the athletes in this cohort did not engage in acute, harmful weight-cutting practices often seen at higher competitive levels. However, the fluctuating USG values indicate that maintaining optimal hydration remains a challenge. Based on these findings, we suggest two primary courses of action. First, from a practical perspective, coaches and support staff should implement structured hydration strategies that emphasize consistent fluid intake not just during competition, but throughout the entire pre-competition week to mitigate the observed rise in USG before weigh-ins. Second, for future research, studies should incorporate a larger sample size and more frequent monitoring, including measures of fluid intake, sweat rate, and electrolyte loss, to build a more comprehensive model of the hydration demands in youth judo. Furthermore, investigating the efficacy of educational interventions aimed at coaches and athletes on the importance of hydration for performance and health is strongly recommended.

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Guidelines on Safe Body Weight Regulation Methods: Safe & Strong – Erasmus+ Project

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ABSTRACT

The Safe & Strong Erasmus+ project addressed one of the most critical issues in youth combat sports—unsafe and rapid body weight reduction (*BWR*). Despite being widespread among young judokas, aggressive weight loss methods are known to harm physical health, mental well-being, and long-term athletic development. This project aimed to develop educational resources and practical guidelines to promote safe, ethical, and scientifically grounded weight management among adolescent judo athletes and their coaches. The main output, the e-book 'Guidelines on Safe Body Weight Reduction Methods, compiles interdisciplinary knowledge from sports science, nutrition, psychology, and judo-specific coaching practices. The project demonstrates how international collaboration in the Erasmus+ framework can contribute to healthier sporting environments and sustainable athletic careers.

INTRODUCTION

Weight categories are a defining element of judo competition, yet managing body weight safely remains a persistent challenge, especially among young athletes. Research has consistently shown that youth judokas often engage in rapid weight-cutting strategies, including dehydration, fasting, or excessive training in thermally stressful environments (*Artoli et al., 2016; Franchini et al., 2012*). These methods can compromise health, impair performance, and negatively affect cognitive, physiological and psychological development.

Moreover, body-weight control in judo often begins at an early age, frequently before athletes possess the physiological maturity or nutritional literacy required for safe management. Therefore, the Safe & Strong Erasmus+ project (2023–2025) emerged in response to the urgent need for educational materials and preventive strategies aimed at coaches, athletes, and parents. The consortium of European partners from Slovenia (*JK Zmajčki*), Croatia (*JC Rijeka*) and Italy (*JC Yama Arashi*) united under the shared mission of safeguarding young judokas' health while maintaining high performance standards. Through interdisciplinary research and knowledge transfer, the project promoted a paradigm shift from 'rapid weight loss for competition' to 'long-term, safe, and smart weight management.'

Aims and Rationale

The main objectives of the Safe & Strong project were:

1. To identify the risk associated with the Rapid weight loss (RWL) in judo
2. To identify common unsafe practices of body weight reduction (BWR) among youth judokas.
3. To develop guidelines by specialists for safe weight management.
4. To create educational tools that support coaches, athletes, and parents in implementing these nutritional guidelines.
5. To disseminate the results across European judo communities through workshops, seminars, and digital resources.

The project rationale stemmed from a public health and ethical perspective. Young athletes are particularly vulnerable to peer and coach pressure related to body image and competitive advantage. Mismanagement of weight can lead not only to acute dehydration or injury but also to long-term metabolic, hormonal, and psychological consequences (*Sundgot-Borgen & Torstveit, 2010*). Hence, promoting safe BWR practices is both a moral and scientific imperative for modern sports organizations.

METHODS, PROJECT IMPLEMENTATION AND RESULTS

The project was implemented through a multidisciplinary approach combining scientific research, personal experience and educational development. Data collection involved literature reviews, expert consultations, and practical observations of environments in participating clubs and countries. The consortium organised transnational meetings with judo coaches, nutritional specialists and sport science researchers to assess existing practices and design appropriate interventions.

The key intellectual output, the e-book *Guidelines on Safe Body Weight Reduction Methods (2025)*, synthesizes current evidence and provides tools and practical examples on how to manage safe body weight in youth judokas. It is an open-access educational resource freely available to the European judo community.

The content was structured into the following three main chapters:

1. Awareness of Rapid Weight Loss Risks in Judo to Optimise Safe Weight Management in Young Judokas
2. Nutrition Strategy of Young Judokas
3. Experience of Elite Athletes – Example Stories

Experts co-authored each chapter of the e-book, ensuring both scientific validity and real-world applicability. The publication can also be used as a didactic tool for judo clubs, schools, and federations.

Additionally, Workshops and seminars were held where Coaches, athletes, parents, and sports scientists participated in dissemination events, emphasising safe practices and sharing examples from partner countries.

The e-book is freely available to all interested readers. You can access it by scanning the QR code below:



DISCUSSION AND CONCLUSIONS

The Safe & Strong Erasmus+ project highlights the necessity of bridging the gap between scientific research and everyday sports practice. Its multidisciplinary framework demonstrated that when embedded within athletic development, health education can lead to improved performance and well-being. The e-book stands as a tangible legacy, ensuring that young judokas, their coaches, and parents have access to clear, evidence-based recommendations on safe body weight management.

The project also emphasizes the social responsibility of coaches and federations to safeguard minors against harmful practices that persist due to tradition or misinformation. The results support the integration of health literacy into judo education systems, promoting sustainable sports participation and lifelong athlete welfare.

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Access the complete e-book by scanning the QR code below:



Pattern of Rapid Weight Loss (RWL) in Male and Female Juvenile and Cadet Athletes (Aged 12 to 16) of the Portuguese National Judo Team

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INTRODUCTION

Rapid Weight Loss (RWL) is traditionally practiced in combat sports (Franchini et al., 2012). It is defined as an average weight loss of 5% achieved over 5 to 7 days (Khodaei et al., 2015). Most of the time, this practice is based more on tradition and anecdotal evidence than on scientific data (Lakicevic et al., 2021). While the benefits are questionable, particularly in the context of competitive Judo, the health consequences can be severe (including fatalities) (Artoli et al., 2016; Zhong et al., 2025). Acute Rapid Weight Loss significantly increases tension and markedly decreases vigor. When judo athletes undergo weekly RWL of $\geq 5\%$, their mood states worsen significantly, regardless of gender (Lakicevic et al., 2024). Rapid weight loss in children and adolescents remains under-researched, particularly in Juvenile (13–14 years) and Cadet (15–16 years) age groups. Aggressive weight cutting can negatively affect hormonal regulation and lead to behavioral changes such as reduced self-confidence, lower motivation to fight, competition anxiety, decreased mental toughness, fatigue, tension, lack of vigor, and depression (Zhong et al., 2025). According to Kraemer and Fleck (2005), increases in maximal strength typically lag behind gains in height and fat-free mass, reflecting the sequential influence of growth, hormonal changes, and neuromuscular maturation. This pattern supports the notion that, during rapid growth periods, muscle mass develops before the ability to fully express force. This evidence challenges the adoption of rapid weight loss (RWL) strategies in youth sport, as such practices have been associated with impaired linear growth, reduced accretion of muscle and bone mass, and disruptions to endocrine function. These adverse effects may compromise normal maturation, increase injury risk, and pose significant short- and long-term health concerns for young athletes during critical developmental windows (Artoli et al., 2010; Franchini et al., 2012; Lakicevic et al., 2022).



Figure 1. Effects of Acute Rapid Weight Loss (Lakicevic et al., 2024).

OBJECTIVES

This study aimed to investigate the habits and practices of Rapid Weight Loss (RWL) among male and female Juvenile and Cadet athletes aged 12 to 16 in the Portuguese national Judo team.

METHODS

Study design: A cross-sectional observational study was conducted to survey the athletes and investigate their RWL practices.

Sample: A non-probabilistic sample of 113 national Juvenile and Cadet athletes: (i) 62.8% male and 37.2% female; (ii) aged between 12 and 16 years; (iii) average male weight: 60.2 ± 21.8 kg, female weight: 55 ± 9.9 kg; and (iv) average male height: 1.69 ± 0.09 m, female height: 1.60 ± 0.07 m.

Instruments and procedures: The Rapid Weight Loss Questionnaire (RWLQ) (Artoli et al., 2016; Zhong, 2025) was used to characterize weight loss habits. Additionally, an in-person questionnaire was administered during a national team training camp in Coimbra, from December 17 to 20, 2024.

Statistical analysis: Relative frequencies were used to analyze and summarize the data, and results were presented graphically (bar charts). The statistical software SPSS (version 25, SPSS Inc., Chicago, IL) was used for data analysis.

RESULTS

Competitors draw upon multiple sources of information concerning rapid weight loss (RWL) practices. Figure 2 illustrates the frequency distribution (%) of RWL methods (A and B) employed by Juvenile and Cadet athletes from the Portuguese National Judo Team ($n = 113$). Beyond self-directed experiential learning, athletes acquire guidance from peers (other judokas), coaches, and parents, as well as from digital media platforms, online content, and printed educational materials (Figure 3).

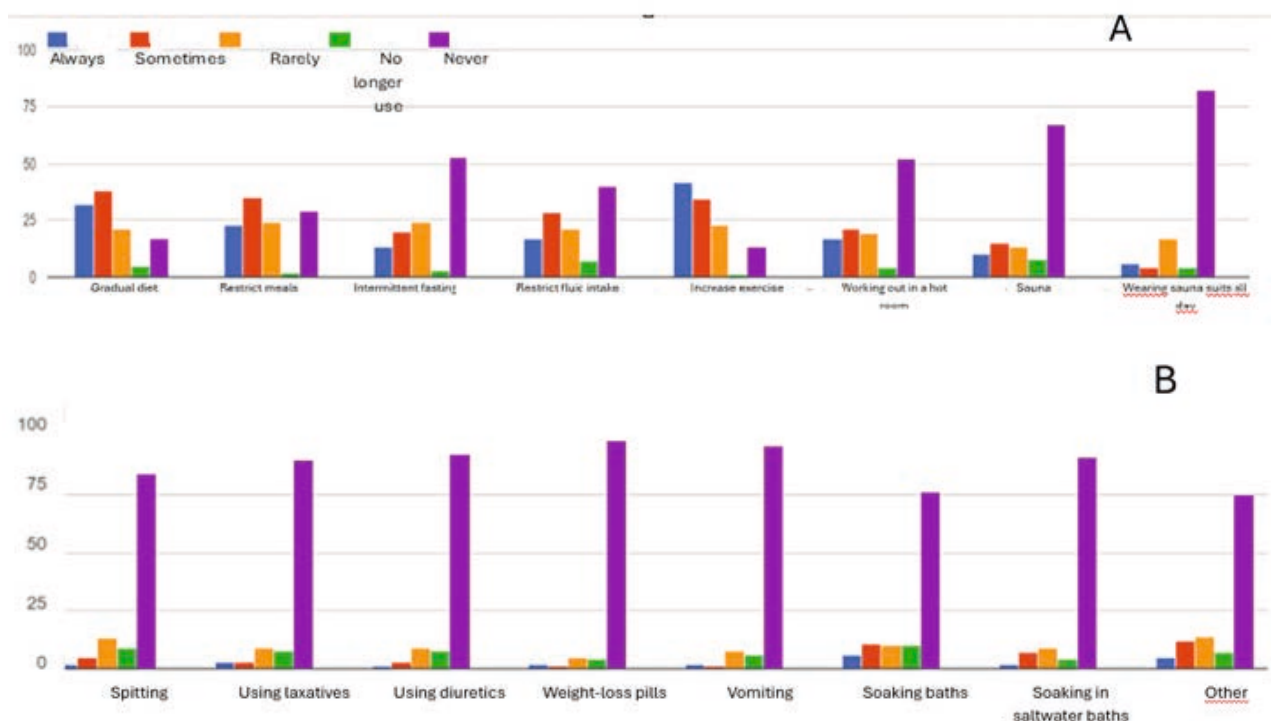


Figure 2. Frequency analysis (%) of weight loss methods (A and B) used by Juvenile and Cadet athletes of the Portuguese National Judo Team ($n = 113$).

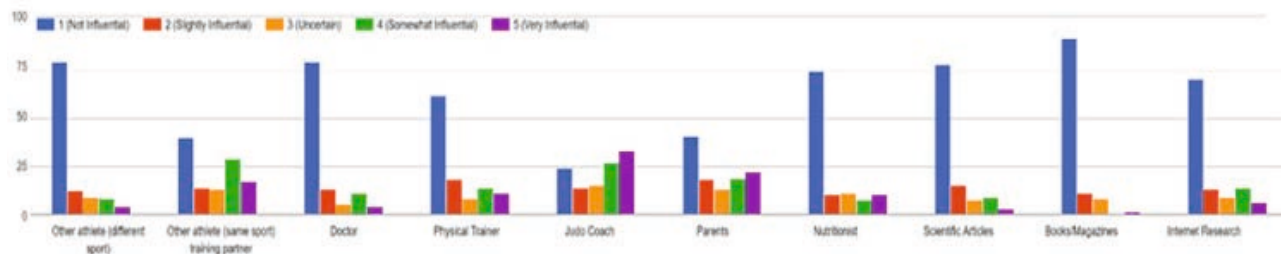


Figure 3. Frequency analysis (%) of the sources of influence on weight loss practices used by Junior and Cadet members of the National Judo Team (n = 113).

DISCUSSION AND CONCLUSION

Weight loss practices are prevalent among Juvenile and Cadet judokas, observed in approximately 82.3% of participants, with a higher prevalence among males.

The longest reported weight loss periods were up to 15 days, with 60% of athletes reporting durations between 3 and 10 days.

The most commonly used weight loss methods included gradual dieting, increased exercise, training in heated rooms, fluid restriction, skipping meals, sauna use, and immersion baths.

Physical trainers, coaches, and parents exert greater influence over RWL practices than health professionals such as doctors and nutritionists (Zhong et al., 2025; Lakicevic et al., 2024; Lakicevic et al., 2022).

This study reveals that RWL practices are present from early competitive ages in Judo, with high prevalence and intensity levels that may pose health risks and impact physical development and performance ((Zhong et al., 2025; Lakicevic et al., 2024; Lakicevic et al., 2022; Štangara et al., 2022).

These findings highlight the need to raise awareness among coaches, athletes, and families about safer weight management strategies and to implement specific educational programs for youth categories.

Practical Applications

The recommendations of EJU for All participants at the U15/U13 (*EJU Hopes Tournament*), weight management practices such as "making weight", "cutting weight", or "running off weight" are not acceptable and should not be encouraged. Judoka should compete in the weight category in which they naturally fall at the time of the weigh-in (*EJU, 2025*).

Coach, athlete, and parent education should be prioritized; with education materials made available by Judo federations as part of coaching qualifications and athlete registration (Štangara et al., 2022).

Conduct further studies on children and adolescents regarding this topic: Emphasize potential gender differences; Explore age-related differences in RWL practices; Prioritize both physical and mental health of athletes.

Ban Rapid Weight Loss practices among children and adolescents an prohibiting dehydration-based RWL methods and athletes engaging in these to be prohibited from competition.

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The Coach–Athlete–Parent Triangle in Judo: Communication Gaps Between Coaches and Parents Regarding Weight-Category Decisions and Rapid Weight Loss before competitions in the Youth Cadets category

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ABSTRACT

Background: Rapid weight loss (*RWL*) is a widespread practice in judo, often used to achieve a competitive advantage by competing in lower weight categories. However, *RWL* poses serious health risks, particularly among youth athletes. Despite coaches and parents being central figures in young judokas' development, little is known about their communication regarding weight management. **Aim:** This study explored the extent of coaches' communication with parents about setting weight categories and managing body weight in the U18 cadet judo category. **Methods:** A modified version of the validated Rapid Weight Loss Questionnaire (Artoli et al., 2010) was distributed to parents ($N = 25$) of U18 judokas through the Slovenian Judo Association. Descriptive statistics were analysed using SPSS 31. **Results:** 68% of parents reported no communication with coaches about weight-category decisions before the season, and 60% indicated no communication regarding *RWL* before competitions. Meanwhile, 72% of parents reported their child had engaged in *RWL* practices. **Conclusion:** Findings reveal limited coach–parent communication on weight management in youth judokas. Strengthening collaboration and sharing the responsibility within the coach–athlete–parent (*C–A–P*) triangle could be crucial to promote ethical, informed, and health-oriented practices in young athletes.

Keywords: *combat sports, children, training, development, risks, communication,*

INTRODUCTION

In judo, athletes are classified into weight categories that require them to remain within a narrow body mass range. This means that competitors often aim to stay at the upper limit of their weight class to gain a physical advantage over lighter opponents (Berkovich et al., 2016). It is common practice for judokas to reduce body mass to compete in a lower weight category. Rapid weight loss (*RWL*) refers to a non-gradual reduction in body mass from 2% to 10% over a few days before the competition weigh-in session (Artoli et al., 2016). Common practices include food and fluid restriction combined with dehydration through induced sweating, which can have negative physiological consequences that impair athletic performance and pose health risks (Thompson et al., 2017).

These adverse effects are especially dangerous among youth judokas, where research has shown alarming prevalence rates. For instance, Berkovich et al. (2016) reported that 74% of youth athletes experienced *RWL* before age 13, raising serious concerns about safety in youth sports. In Slovenia, research has reported that 59% of youth competitors reduce their body mass before competitions. They do so unplanned and unsupervised, as on average 55% of competitors begin reducing their body mass by 4.2 ± 0.99 kg only 3–5 days before the competition (Kukovica et al., 2023). Moreover, Yoshida et al. (2024) found that 51.8% of participants had lost weight for competition during junior high school (ages 12–15). Importantly, those who practised weight reduction during periods of secondary sexual development were found to be significantly shorter in adult height than those who did not ($p < .05$), suggesting that weight loss during growth spurts may adversely affect normal development. Moreover, the study indicated that *RWL* during junior high school years does not contribute to improved competitive performance.

Nevertheless, this raises crucial questions: Where are parents in this process, considering they are legally responsible for their children's health and welfare? Do they receive information from their children's coaches? Research on parental involvement in judo, especially in the context of rapid weight loss and weight category determination, remains scarce

to date. Are parents even included in these critical discussions? A strong, coordinated coach–athlete–parent (*C–A–P*) triangle is essential in combat sports when determining a sustainable, season-long weight category and preventing the widespread issue of RWL. According to Hellstedt (1987), the effectiveness of this triangle depends on balanced communication, mutual respect, and clearly defined roles among the three parties. Therefore, the main aim of this research was to explore coaches' communication with parents regarding the process of setting weight categories and managing body weight before competitions in the cadet age category.

METHODS

For data collection, we adapted and modified the validated Rapid Weight Loss Questionnaire (*RWLQ*) for judo (Artoli *et al.*, 2010) and the questionnaire used for the Weight Loss Practices for Elite Judokas (Štangar *et al.*, 2022). The questionnaire was created and distributed using the online survey tool 1KA via emails to the clubs and members of the Slovenian Judo Association and QR codes in the clubs. Descriptive statistics were performed using SPSS version 31.

RESULT

In total, 25 parents filled out the questionnaire in the cadet U18 category. Eleven parents were male, and fourteen were female, while 14 of their children were male and 11 were female. According to the rules and regulations of the Slovenian Olympic Committee, only five children were not categorised as athletes.

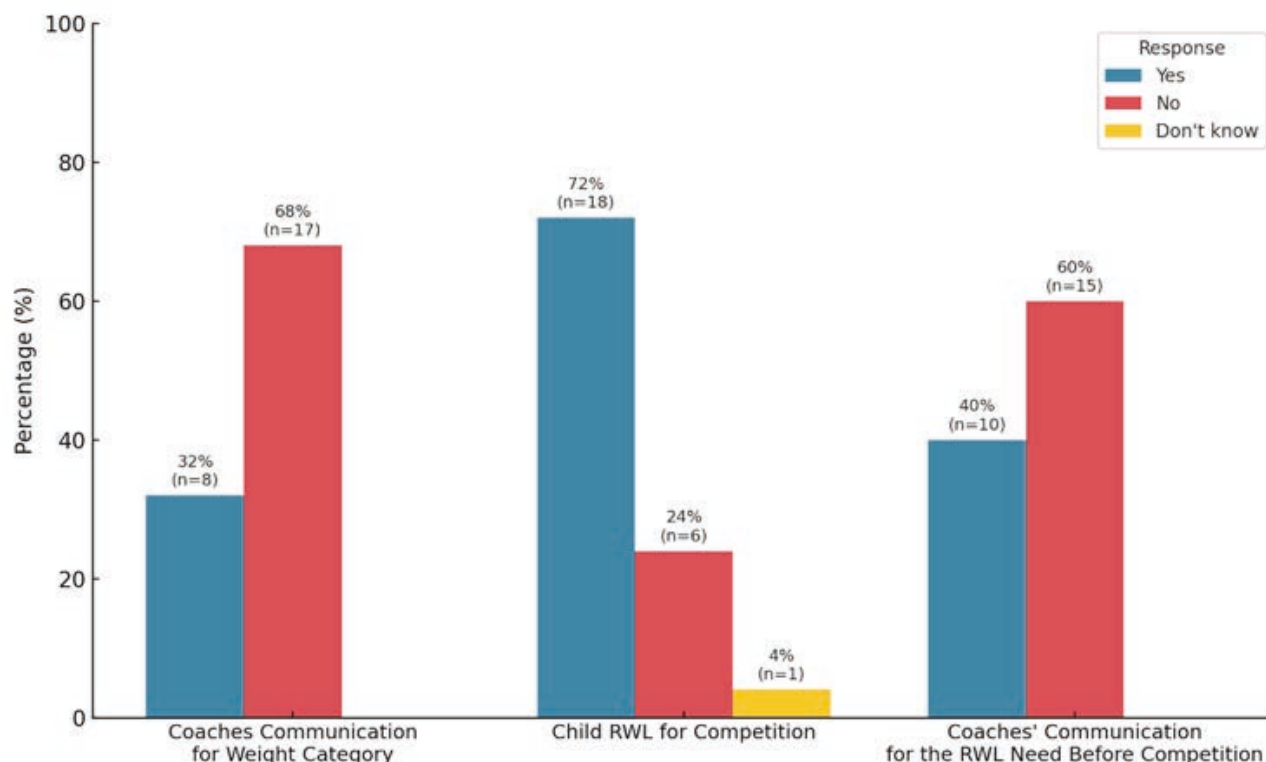


Figure 1. Data regarding parents' communication with coaches

The data from parents of U18 judokas show that only 32% reported receiving information or communication from coaches regarding the decision on setting the weight categories before the start of the competitive season. In comparison, 68% of parents indicated no such communication. Regarding children's rapid weight loss (*RWL*) for competition, 72% of parents reported that their child had to reduce body mass prior to competitions, 24% reported that their child did not, and 4% were unsure. Additionally, 40% of parents noted that coaches communicated about the need for *RWL* before competition, whereas the majority (60%) reported no coach communication on the *RWL* need before competition.

DISCUSSION

The present study results highlight a notable communication gap between coaches and parents in the context of weight management among U18 judokas. Although the majority of athletes reportedly engaged in rapid weight loss (*RWL*) before competition, less than half of parents indicated receiving information or guidance from coaches on weight-category decisions or *RWL* needs before competitions. This finding suggests a lack of structured dialogue and educational support in the coach–athlete–parent triangle, which may contribute to the persistence of unsafe weight-management behaviours in youth judo.

Previous research emphasises that effective communication and collaboration among coaches, athletes, and parents are essential for fostering a healthy sporting environment (*Hellstedt, 1987; Lisinskiene et al., 2019; Santos et al., 2024*). When communication is poor or inconsistent, youth athletes may rely on peer or informal sources of advice, which often promote harmful weight-cutting behaviors. Such practices are particularly concerning in youth judo populations, as *RWL* can lead to severe acute and chronic consequences, including dehydration, hormonal imbalance, and impaired growth and development (*Lakicevic et al., 2022*).

Moreover, open communication is vital for an athlete's well-being and an important protective mechanism for coaches, helping them fulfil their duty of care and safeguard against ethical or legal repercussions related to an athlete's health (*Mayhead, 2023*). When problems arise, coaches might be the first ones to be blamed (*Knight & Harwood, 2009*). Therefore, we suggest that coaches should set the weight category of their youth athletes at the beginning of the season, together with parents and athletes. In this way, parents and athletes should be aware of possible *RWL* before competitions, and this should also be clearly stated to them from the coach's side. Fostering shared power distribution and responsibility among coaches, athletes, and parents requires open communication and clearly defined roles. The complexity of this collaborative process highlights the necessity for mutual understanding of each party's rights, duties, and procedures, ensuring that decision-making and outcomes are viewed as shared responsibilities rather than belonging to a single individual (*Ntalachni et al., 2025*).

CONCLUSION

The present study highlights a substantial gap in coach-parents' communication regarding weight-category decisions and rapid weight-loss (*RWL*) practices among U18 judokas. The findings indicate that while *RWL* is common in this age group, while structured dialogue and joint decision-making between coaches and parents are largely absent. Given the known physiological and psychological risks associated with *RWL* in youth athletes, this communication gap represents a critical area for intervention. Therefore, establishing open, transparent, and consistent communication within the coach–athlete–parent (*C–A–P*) triangle is essential to ensure informed decision-making, distribute responsibility reasonably, and safeguard both athlete welfare and coach accountability. Parents should be involved in setting realistic weight categories at the start of the season, which could help align/manage expectations, reduce risky weight-management behaviours, and foster shared responsibility for both success and setbacks. Future work should expand these findings by including larger samples, coaches' and athletes' perspectives and exploring how educational programs or policy frameworks can strengthen cooperation and ethical practice in judo.

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The Development, Dissemination, and Assessment of a Knowledge Translation Tool for Disordered Eating and Body Image in Judo

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ABSTRACT

This study aimed to address the knowledge-transfer gap that exists within the field of disordered eating and body image dissatisfaction in judo. A composite letter to younger self was translated into audio and video resources. In total, 37 participants (*athletes, coaches, parents, and practitioners*) engaged with the resources and provided feedback within an online survey. Thematic analysis identified four themes: The emotive impact, issues raised in the resource, take home messages, and future dissemination and education. Participants reflected on harmful cutting weight practices, emphasised dissemination to youth athletes, coaches, and parents, and acknowledged the long-term health risks that the resources highlighted.

INTRODUCTION

The mental health and wellbeing of elite athletes have received increasing attention in both the scientific literature and sporting organisations (Lundqvist *et al.*, 2023). Sports participation, its related pressures, and body image dissatisfaction, put athletes at greater risk for the development of disordered eating compared to the general population, with eating disorders being one of the most reported psychiatric pathologies in elite sport (Karrer *et al.*, 2020). Indeed, disordered eating, eating disorders, and body image dissatisfaction in athletes have received a large amount of media coverage. For example, in 2020, the BBC released two documentaries, one presented by former athlete Colin Jackson (*Sport's Hidden Crisis*) and the other by retired England cricketer Freddie Flintoff (*Living with Bulimia*).

Nonetheless, a knowledge-transfer gap appears to exist, preventing potential users such as athletes, coaches, and practitioners from addressing mental health and wellbeing concerns (Lundqvist *et al.*, 2023). With documented dissemination and research translation barriers present, it stresses the importance of developing appropriate knowledge translation tools for these potential users (Everard *et al.*, 2023). Outside of elite sport, knowledge translation training programmes have been used to help teachers, fitness instructors, and public health practitioners identify disordered eating, with increased knowledge and confidence levels regarding associated symptoms (McVey *et al.*, 2008). Also aiding in the prevention of disordered eating, are body image dissatisfaction interventions, which can help to decrease negative image perceptions, and increase body esteem and appearance satisfaction (Franko *et al.*, 2013).

The purpose of this study was to (1) construct a video and audio resource and (2) assess the potential users' perceptions of these resources. As such, we aimed to bridge the disordered eating and body image dissatisfaction knowledge-transfer gap by translating a composite letter and disseminating the constructed resources to assess their impact with potential users.

RESOURCE CREATION METHOD

Procedure

The resources were created using a composite letter to a younger self that was created in an earlier study by the authors with 15 retired judoka (6 male, 9 female; Mean age = 42.7, SD = 11.4 years). Here each retired judoka partook in two interviews and were asked to think of a time within their competitive career they would have liked to receive a letter from their older, wiser, and more knowledgeable self. The experiences and voices of all 15 participants were analysed and integrated into a single account. As such, the letter should be read as coming from a singular composite character in relation to advice that he/she would give their younger self on their judo journey. A voiceover was created initially

for the audio resource by the first author (*female*) and a close friend (*male*), ensuring representation, relatability, and transferability (Everard et al., 2023). The video was then generated, using judo training sessions, close-up, and specific footage to highlight important sections of the letter, ensuring resonance (Szedlak et al., 2019).

Participants

The participants for the video resource included the first author, a close friend, and members of a martial arts club. To be a member of the club, all members, parents, and guardians signed a waiver form stating they agreed to being filmed and photographed. The first author also made all those aware this specific filming was taking place and its purpose. No one objected to this, and the filming commenced.

Results

Two resources were created from the composite letter to younger self: Video Resource and Audio Resource. A link was also provided to the participants for the written version: Letter Resource.

RESOURCE IMPACT METHOD

Participants

The research was conducted with potential users (*athletes, coaches, parents, and practitioners*). In total, 37 participants (*Mean age = 40, SD = 14 years old*), 15 athletes, 11 coaches, 11 parents, six practitioners, and two other (*i.e., former athletes*) provided written informed consent to partake in the research.

Procedure

An online survey was created using Jisc. The first section consisted of demographic questions and background information, where participants were asked to specify which potential user they were (*i.e., an athlete, coach, parent, practitioner, or other*). Participants were provided with links to the video, audio, and written resource, but were only asked to listen to the audio file if they were visually impaired. The potential users were asked a number of open questions to assess the resource impact. Example questions included: What are your initial thoughts about the resource? In what way does it impact you? What would your take-home message be? Who do you think this resource would impact the most, and why? The survey concluded by asking participants if they had any further comments, and a thank you note.

Data Analysis

Free-text comments were retrieved from Jisc and analysed thematically (Braun & Clarke, 2006). Responses were read and re-read, data codes were generated, which were then used to develop potential themes. These were then reviewed by both authors, before being defined and named, and the report written up.

RESULTS

Following thematic analysis, four themes were developed: The emotive impact, issues raised in the resource, take home messages, and future dissemination and education. These are presented below with direct participant quotes, depicting the end user, with pseudonyms allocated for anonymity.

The Emotive Impact

This theme demonstrated the emotive impact of the resources. Participants felt: “Uncomfortable, concerned, and even a little bit disgusted” (*Jo, practitioner*), indicating the powerful emotions the resources elicited. One participant felt that the resource may have been triggering: “I had an eating disorder in my teenage years and watching a very slim girl telling me not to worry about my weight would have been triggering back then” (*Anna, retired athlete*).

The resources also helped participants consider components of judo that they may not have done previously, such as living in hunger and loneliness:

The resource highlighted aspects I had not previously considered e.g., living in hunger and the loneliness and isolation associated with this that athletes might experience every time they go through a weight cutting period and how they may never have a healthy relationship with food again (*Emily, practitioner*).

Issues Raised in the Resource

The resources helped former athletes to reflect on their past experiences: “I can remember the unhealthy weight cutting practices and training in bin bags to dehydrate. It takes me back to a very unhealthy time where my relationship with food was all about that cut” (*Sharon, coach*). The social element of cutting weight was also portrayed in the resources, which highlighted the loneliness and isolation that athletes who engage in cutting weight experience: “Having cut weight for competitions in the past I used to feel so lonely, especially as I was a first-year student in university and in turn, missed out or didn’t fully enjoy many social events” (*Martin, current athlete*). Concerns surrounding the long-term implications of cutting weight were also noted by parents: “It makes me think about the long-term impacts of cutting weight. I worry about children cutting weight and this restricting their growth and development outside judo. They are not considering the long-term impact and just short-term goals/winning” (*Yvonne*).

Take Home Messages

The participants recognised that while weight is an innate part of weight categorised sports, it should not dictate an athlete’s life, as they need to grow and develop as an individual outside of sport too:

Your weight is important as a competitive judoka, but it is not the most important thing in the world, and although judo will be a big part of your life, there will be life after judo that is just as important (*Jack, parent*).

The resources made the participants question whether cutting weight benefits sports performance, demonstrating that they got the participants to think and reflect:

I loved the section about not being afraid to move up a weight category, listening to your body, growing and developing into a weight category, fuelling your performance, and using and relying on your judo ability as providing a healthy alternative. There needs to be so much more emphasis on this vs the old unhealthy myth that being lighter is better. It gives hope that the cycle can be broken! (*Emily, practitioner*)

Future Dissemination and Education

The participant responses to the final survey question: “Who do you think this resource would impact the most?” provided insight into who the resources should be disseminated to. The majority, 73% of the participants, believed that the resources would most impact youth athletes:

It’s important to explain to them that it’s absolutely alright to change weight categories related to their current weight, as it will put less pressure on their mental health and overall wellbeing, and they will be able to enjoy their sport journey as they should do (*Lydia, current athlete*)

Another important group was parents/guardians (30%): “Parents, especially those who see lighter as a way of success in early judo careers” (*Sharon, coach*). Coaches were also identified as a key group (19%): “Help them support their athletes in healthier ways, creating a better balance between performance and wellbeing in weight-focused sports” (*Tariq, parent*).

DISCUSSION

When engaging with the resources, participants felt upset, disappointed, uncomfortable, concerned, and disgusted. These emotions were elicited not only because of the content of the resources, but also the way they were created, through using specific and close-up footage and incorporating emotive background music. The athletes and coaches reflected on their past experiences of cutting weight when engaging with the resources, and in re-experiencing these events and emotions, a personal connection was formed (*Everard et al., 2023*).

The resources raised important issues regarding cutting weight, such as the unhealthy cutting weight practices, the associated social repercussions, and physical and mental health consequences. Raising awareness of the impacts of cutting weight is as an important factor in the early identification and prevention of disordered eating in athletes (*Wells et al., 2019*).

The participants identified several individuals that the resources should be disseminated to, the most important one being youth athletes. Young athletes engaging in these practices is concerning, as it can have major physical and psychological implications. Parents/guardians and coaches were also identified as groups that the resources should be disseminated to, as youth combat sport athletes are heavily influenced by these individuals (*Lakicevic et al., 2022*).

Being encouraged not to cut weight and instead developing and growing into a new category was one of the key take home messages. As such, the translation of research into resources could be successfully argued, as they were effective in communicating information to and fostering reflection in the participants.

CONCLUSION

Through demonstrating how these resources were developed, we hope it will remove some of the ambiguity surrounding the generation of knowledge translation tools (*Everard et al., 2023*), therefore increasing uptake. The resources should be disseminated to populations inside and outside of judo, helping develop a deeper understanding of unsafe cutting weight practices, and the consequences of these methods on physiological and psychological health.

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Bilirubin as a Novel Biomarker of Oxidative Stress in Judo Athletes: A Non-Invasive Approach

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ABSTRACT

This pilot study investigates bilirubin as a novel stress biomarker in judo athletes, comparing it with standard biomarkers (*cortisol*, *amylase*, *MDA*) across blood, urine, and saliva. Using a high-throughput fluorometric assay (*HUG*), bilirubin and its conjugate were quantified before and after training and competition. The findings position bilirubin not only as a liver function indicator but as a positive, adaptive biomarker of antioxidant response, supporting its use for non-invasive monitoring of athlete health, recovery, and overtraining risk.

Keywords: *bilirubin, oxidative stress, judo, non-invasive monitoring, biomarkers, cortisol*

INTRODUCTION

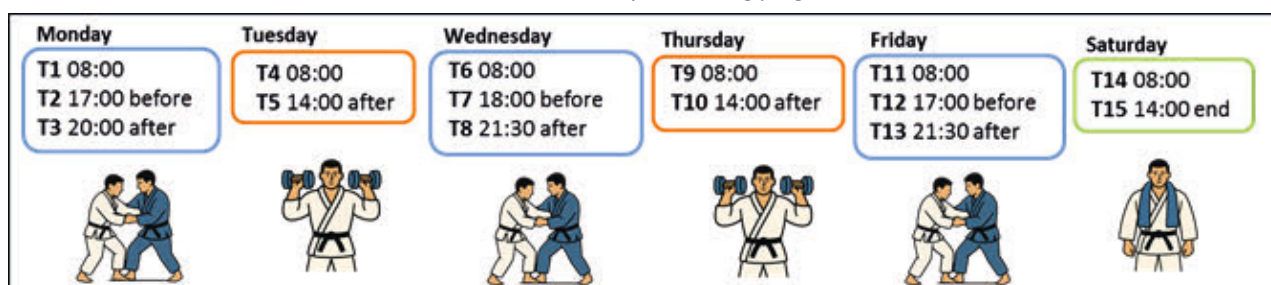
Most studies conducted over the past two decades have consistently reported increased oxidative stress, regardless of the type or intensity of activity (Power, 2020; Squillacioti, 2021). Judo, in particular, is an acyclic sport whose performance depends on a combination of different physical abilities, with high-intensity, intermittent actions (Gandouzi, 2023). Oxidative stress can contribute to muscle fatigue, inflammation, and, in severe cases, an increased risk of overtraining (Finaud, 2006) and injury (Lewis, 2020). The use of biomarkers has become an essential monitoring tool in sport and exercise medicine, and bilirubin is considered a good biomarker of oxidative stress as well as a powerful antioxidant (Woronyczová, 2022). Moderately elevated bilirubin concentrations may provide adaptive and protective advantages in response to oxidative and inflammatory stress. Athletes, especially elite athletes, tend to have higher bilirubin levels than sedentary individuals. This appears to be a protective physiological adaptation rather than pathology (Witek, 2017). Consequently, bilirubin should be interpreted not only as a marker of liver damage but also as a potentially positive factor for health and athletic performance (Flack, 2023). Monitoring athletic performance during training and competition requires analytical methods that are fast, simple and inexpensive, along with non-invasive sampling techniques capable of indicating any psychological or physical imbalance at an early stage to prevent failure or injury. The aim of this pilot study is to evaluate the novel biomarker bilirubin in urine, saliva and blood obtained from Judo athletes. The study develops a fast, simple and inexpensive monitoring method, along with non-invasive sampling techniques, to assess circulating levels of bile pigments and stress parameters to evaluate both psychological and oxidative stress in individual Judo athletes.

METHODS

Subjects and sampling protocol

Nine medium-level judoka (four male, 16 - 22 years; five female, 14 - 27 years) from the Friuli Venezia Giulia region, Italy, were recruited following an established protocol (Sist et al., 2022). The study was submitted to and approved by the Ethics Committee of the University of Trieste. One of these athletes was selected for closer observation during a one-week Judo session to determine parameter values across the three different biological fluids (Scheme 1), whereas urine and saliva samples from the other athletes were collected before and after a competition.

Scheme 1. Blood, saliva and urine weekly monitoring program related to Athlete 1.



Samples were self-collected non-invasively by the athlete. Following thorough instructions, stimulated saliva was collected using a sterile Salivette (Sarstedt®) and urine in a sterile 50 mL Falcon tube. These samples were promptly transported to the lab and frozen at -80°C for later analysis (Sist et al., 2022). Capillary blood was obtained via a finger-prick device.

Biochemical parameters

The quantification of bilirubin (BR) and its congener bilirubin glucuronide (BRG) employs a high-throughput fluorometric method based on HUG fusion protein (Pelizzo et al., 2023; Sist et al., 2023). Creatinine (CRE) was determined using the Jaffe method (1886). Cortisol was analyzed via HPLC-UV based on a method by Pihut et al. (2015) with modifications. Malondialdehyde (MDA) was measured by HPLC with fluorescence following Agarwal et al. (2002). Amylase activity was quantified using a commercial assay kit (Sigma-Aldrich).

RESULTS AND DISCUSSION

Assessing baseline bilirubin levels in saliva and their changes after stressful situations is an innovative measure that is not currently used, as the concentrations are very low and cannot be detected by conventional analytical methods.

Bilirubin recovery test

A spike-and-recovery test was conducted by adding known amounts of BR to known volumes of a single pool of saliva, urine specimens and control (albumin solution). No significant difference in BR concentration was found between saliva, urine, and the albumin solution (Table 1) indicating no matrix effect in the assay.

Table 1. Recovery of BR in blood, urine, and saliva under spiking conditions.

Sample (n)	Spike Level, nM	Expected BSA	Observed	Recovery %	p-value
Blood (n=2)	Low	9.4 (±0.5)	9.5 (±1.4)	101	0.309
	Med	26.0 (±2.2)	25.8 (±3.8)	99	0.735
	High	46.2 (±1.6)	46.6 (±1.9)	101	0.046
Urine (n=2)	Low	10.3 (±0.1)	11.6 (±0.4)	112	0.434
	Med	24.3 (±1.0)	24.6 (±0.1)	101	0.255
	High	47.7 (±3.4)	48.5 (±0.6)	101	0.192
Saliva (n=2)	Low	10.9 (±0.1)	10.8 (±1.1)	98	0.839
	Med	25.7 (±1.1)	24.6 (±1.1)	96	0.100
	High	50.2 (±0.4)	49.4 (±0.6)	98	0.161

Results were analyzed by 2-way ANOVA test using standard significance level $\alpha = 0.05$.

Quantification of BR and BRG

Figure 1(A) shows that BR and BRG values in the blood of athletes are in the same μM range and remain within physiological ranges of 11–21 μM and 0–0.7 μM , respectively. In addition, excess BR resulting from physical activity

appears to be rapidly eliminated as BRG, particularly through urine and also through bile, to keep levels below toxic limits.

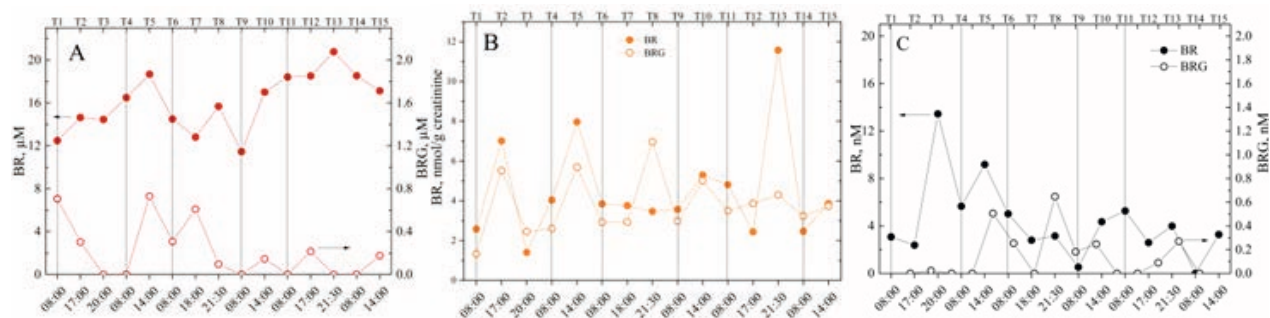


Figure 1. Bilirubin (BR) and conjugated bilirubin (BRG) concentrations in (A) blood, (B) urine, and (C) saliva samples during the training week.

In urine, BR and BRG values are in the same nmol/g creatinine range, as shown in Figure 1B. BR and BRG in morning urine samples at 8:00 have average values of 3.4 ± 0.9 nmol/g CRE and 2.8 ± 0.7 nmol/g CRE, respectively. In contrast, these parameters show a marked increase in concentration after a training session, rising up to the 11.5 nmol/g CRE for BR and up to 6.9 nmol/g CRE for BRG. In saliva samples (Figure 1C), BR values were always higher than BRG, while in urine BRG values tended to remain higher than BR, consistent with BR metabolic clearance.

Quantification of other stress biomarkers

MDA values in urine appeared more sensitive to physical activity than those measured in blood or saliva. Therefore, urine specimens were the preferred matrix in the MDA monitoring assessment. Salivary, urinary, and blood MDA concentrations are reported in Figure 2A. The salivary and urinary cortisol (S-CORT and U-CORT) concentrations after different physical activities are reported in Figure 2B. Compared to the measurements at pre-training events, both U-CORT and S-CORT increased significantly at post-training phases T3, T7 and T13, with wide variations observed for U-CORT (Figure 2B). The results highlighted that high- and middle-intensity training differently increases the body's cortisol and α -amylase levels in both saliva and urine. More precisely, greater variability is observed in U-CORT, while conversely, greater variability is observed in salivary α -amylase (S-AA) (Figure 2C) with rapid response with marked peak values at the end of the physical exercise.

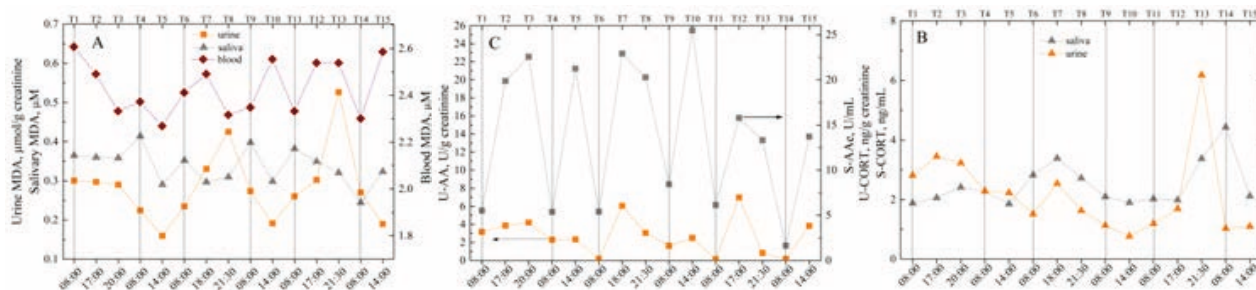


Figure 2. (A) MDA concentrations in urine, saliva and blood, (B) salivary and urinary cortisol concentrations, (C) salivary and urinary amylase concentrations during training week.

Much more than cortisol, which tends to remain elevated during and after peak stress, α -amylase showed a more rapid pattern, peaking immediately after a stressful event and then quickly returning to baseline (Figure 2C). This makes α -amylase a useful indicator for detecting immediate changes in stress activation, whereas cortisol provides a more comprehensive and prolonged view of the hormonal response.

Effect of competition on bilirubin level and on oxidative stress parameters

In high-intensity sports such as Judo, which are characterized by explosive efforts and intense emotional pressure, competitions can generate significant physiological and psychological responses. Amylase and cortisol are complementary biomarkers of stress (Ciaccioni, 2024; Kivlighan, 2006; Salvador, 2003) and the interaction between these two biomarkers is complex and depends on several factors, including the duration and intensity of stress, the athlete's training level, and their psychological response to the load. S-AA and S-CORT in addition to oxidative stress parameters like BR were measured in eight athletes (2–9) during three periods (Figure 3B) and the results are presented in Figure 3A. Almost all the athletes showed a marked increase in total BR (TBR) in urine just before (T1) and after competition (T2) compared with T0. The numbers on the top of bars in Figure 3A indicate the S-CORT concentration. It can be seen that higher cortisol values correspond to higher TBR values. S-AA (Figure 3C) showed a significant increase from the rest period (T0) to 1 hour before the competition (T1), and then showed a trend towards a decrease after the event. S-AA and S-CORT trend indicates higher levels of both anxiety and physical stress.

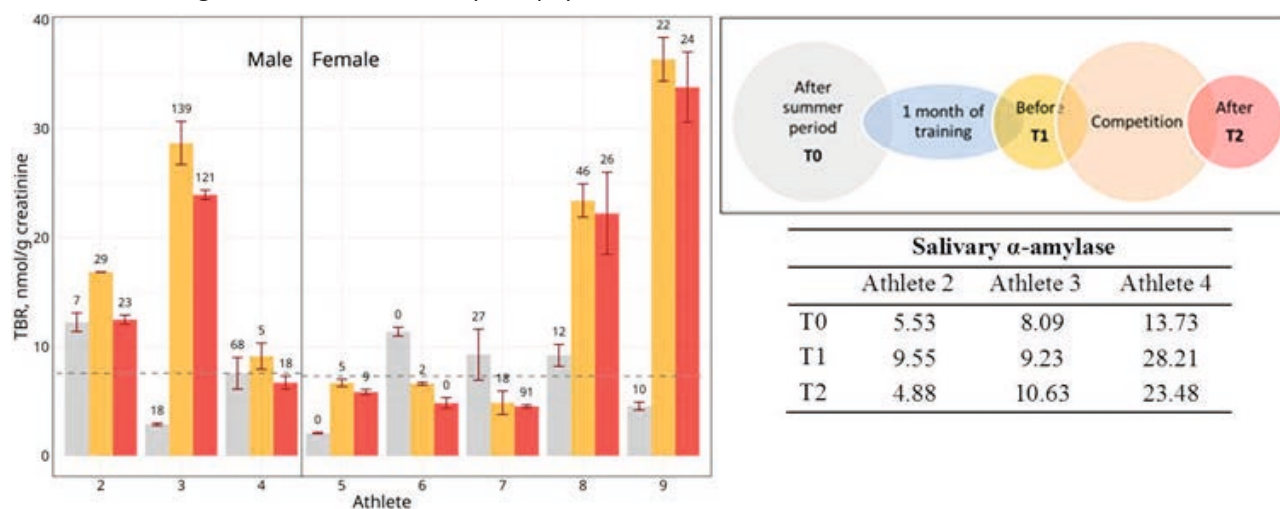


Figure 3. Total BR in urine (bars), S-AA (in table) and S-CORT values (numbers on the bars as ng/mL) of athletes before and after Judo competition. (Grey bar = T0, yellow bar = T1, red bar = T2; dashed line indicates the average basal value T0 = 7.3 ± 3.7 nmol/g CRE and 7.6 ± 4.1 nmol/g CRE for female and male, respectively).

Correlation analysis between all the parameters

All results obtained for the nine athletes were statistically processed, and the Kendall correlations were obtained using R and ggplot2. The sample size is small, and the significance obtained may be affected by this; therefore, this analysis should be considered preliminary.

There was a positive correlation ($\alpha=0.283$, $p=0.028$) between total urinary BR (U-TBR) and total blood BR (B-TBR) suggesting the possibility of measuring BR in urine rather than blood. There is also a weak correlation ($\alpha=0.383$, $p=0.059$) between salivary and urinary BRG. However, as shown in Figure 2, urine values are more sensitive to metabolic changes related to sports activity. Intense exercise can temporarily increase bilirubin levels in the blood and urine, especially if muscle damage is involved (e.g., through eccentric exercise) or if there are changes in liver metabolism. However, a fairly strong correlation between U-TBR and B-TBR (blood) ($\alpha=0.283$, $p=0.028$) suggests that bilirubin levels may indicate how the body manages detoxification processes in both the liver and kidneys.

S-CORT correlated well with urinary amylase (U-AA) $\alpha=-0.534$, $p<0.001$), U-BR ($\alpha=0.243$, $p=0.029$), and U-MDA ($\alpha=0.335$, $p=0.003$), suggesting fairly good correlations between psychological and physiological parameters which could indicate a reduction in athletic performance during both competition and training. The response of biomarkers such as S-AA and U-BRG ($\alpha=0.223$, $p=0.029$) may indicate how the body adapts to and manages exercise. If these biomarkers are chronically elevated, it may be necessary to review the intensity and frequency of exercise sessions. Bilirubin levels in urine, saliva, and blood are generally positively correlated, which is consistent with physiological expectations. Correlations with cortisol are noteworthy, as they suggest possible interactions between psychophysical stress and bilirubin-related metabolism or detoxification processes. By combining biomarkers of oxidative stress (MDA), endocrine stress (cortisol),

and sympathetic response (*salivary amylase*) with antioxidant markers (*bilirubin*) in accessible matrices such as saliva and urine, it is possible to create a personalized biochemical profile to assess internal load, monitor recovery, prevent overtraining, and optimize performance.

CONCLUSIONS

The study highlighted that bilirubin and bilirubin glucuronide, are not only by-products of liver metabolism but also powerful biomarkers and antioxidants in the response to oxidative stress induced by intense sporting activity, such as Judo. Analysis of different biological matrices (*blood, urine, saliva*) has shown that bilirubin levels increase significantly in response to training sessions or competitions, in parallel with other biomarkers of psychophysical stress such as cortisol, amylase, and malondialdehyde. Urine has proved to be a particularly sensitive matrix for monitoring bilirubin levels, showing an increase after exercise and before and after competition. The results suggest that bilirubin should be considered as marker of the body's adaptation to increased oxidative and inflammatory stress as reported in well-trained athletes that exhibit higher levels of bilirubin. These findings pave the way for the use of bilirubin as an accessible, non-invasive, and informative biomarker, useful for monitoring health status, recovery, and the risk of overtraining in athletes, supporting a more personalized and preventive approach in sports medicine.

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Correlation Between Neuromuscular Fitness and SJFT Performance in Young Athletes

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ABSTRACT

Background: The development of strength, power, and endurance during youth, alongside technical training, likely contributes to better sport-specific performance (Franchini et al., 2007). In judo, the Special Judo Fitness Test (SJFT) is a validated field test that mimics match demands (Sterkowicz, 1995; Kons et al., 2020). This study examined how neuromuscular fitness (muscular strength, power, and endurance measures) correlates with SJFT performance in young judo athletes. **Methods:** Over 250 male and female youth judokas ($\approx 12 - 16$ years) were assessed on neuromuscular tests including upper-body power (medicine ball throw), lower-body power (vertical and horizontal jumps), muscular endurance (push-ups and sit-ups), and handgrip strength. All athletes completed the SJFT, which yields a total number of throws and an index (heart rate-based). Pearson correlation analyses ($p < 0.05$) were used to determine associations. **Results:** Nearly all neuromuscular tests showed significant correlations with SJFT performance. Higher values in lower-body power (e.g. standing long jump) and muscle endurance (push-ups, sit-ups) were associated with more throws and a better (lower) SJFT index ($r \sim 0.36 - 0.46$, $p < 0.01$). Handgrip strength and medicine ball throw distance also displayed moderate positive correlations with total throws ($r \sim 0.30$, $p < 0.01$). Correlations were generally stronger in boys than girls, but the overall trend was consistent for both sexes. **Conclusion:** Neuromuscular fitness encompassing muscular power, strength, and endurance is positively related to judo-specific performance in youth. Stronger, more powerful young athletes achieved more throws and a lower fatigue index in the SJFT. These findings underscore the importance of developing upper and lower limb power and muscular endurance to enhance judo-specific fitness in young judokas (Detanico et al., 2018; Arazi et al., 2017).

Keywords: youth judo; muscle power; aerobic capacity; handgrip strength; Special Judo Fitness Test

INTRODUCTION

Youth judo performance is known to depend on a myriad of physical qualities, including strength, power, and endurance (Franchini et al., 2007; Tavares Júnior et al., 2023). The Special Judo Fitness Test (SJFT) is a popular field assessment to evaluate judo-specific conditioning, as it reproduces the intermittent throwing activity and physiological stress of a judo match (Franchini et al., 2007; Kons et al., 2020). Prior studies have established that SJFT performance (e.g. number of throws completed) relates to both aerobic and anaerobic power of athletes (Tavares Júnior et al., 2023; Detanico et al., 2018). For instance, the number of throws in the SJFT has shown moderate-to-high correlations with laboratory measures like anaerobic threshold velocity ($r \approx 0.60$) and incremental exercise peak velocity ($r \approx 0.70$) (Franchini et al. 2009). These observations suggest that judokas who are more powerful and have greater endurance tend to perform better in sport-specific tests. Additionally, neuromuscular attributes such as upper-body strength and lower-body explosive power are thought to contribute significantly to performance in judo exercises and competition (Bouzouaigh et al., 2023; Detanico et al., 2012).

However, there is limited information focusing specifically on young athletes and the range of basic neuromuscular tests that might predict their judo-specific fitness. Identifying which fitness variables most strongly relate to SJFT performance in adolescents could guide coaches in designing age-appropriate training programs (Franchini et al. 2013). Kons et al. (2020) reported that in youth (ages 11–16), measures of lower-body power (standing long jump) and grip strength explained about 30% of the variance in SJFT results (Detanico et al., 2020). Similarly, earlier work by Detanico et al. (2012) found that both aerobic capacity and muscle power were key determinants of throws completed in the SJFT (Bouzouaigh et al., 2023). These studies underline a multi-factorial influence, but a comprehensive analysis incorporating various strength, power, and endurance tests in young judokas is needed.

This study aims to evaluate the correlation between an array of neuromuscular fitness tests and SJFT performance in young judo athletes. We hypothesize that athletes with higher muscular power, strength, and endurance will perform significantly better on the SJFT (*more throws, lower index*). By pinpointing these relationships, the study seeks to inform training priorities for developing judokas.

METHODS

A sample of 271 youth judokas (182 boys and 89 girls, aged 12–17 years) with more than three years of practice at regional or national level participated voluntarily, with informed consent obtained and ethics approval granted. In a single session, athletes underwent anthropometric measurements, a battery of neuromuscular tests, and the Special Judo Fitness Test (SJFT). Neuromuscular fitness was assessed through medicine ball throws (*seated and standing, 3 kg*) for upper-body power, standing long jump and vertical jumps (*squat and countermovement*) for lower-body power, 30-second push-up and sit-up tests for muscular endurance, and maximal right- and left-hand grip strength using a dynamometer. The SJFT followed Sterkowicz's standard protocol (Sterkowicz, 1995), consisting of three bouts of throws (15 s, 30 s, 30 s) with 10 s intervals, recording the total number of throws and calculating the SJFT index as $(HR_{end} + HR_{1min})/\text{total throws}$, where lower values indicate better performance. Descriptive statistics and Pearson's correlations were applied to examine associations between fitness measures and SJFT outcomes, including subgroup analyses by sex, with significance set at $p < 0.05$.

RESULTS

The athletes were on average 14.5 ± 1.7 years old, corresponding to early-to-mid adolescence. Significant correlations were observed between nearly all neuromuscular tests and SJFT outcomes, confirming our hypothesis. The strongest associations were found for explosive power and muscular endurance: standing long jump correlated positively with total throws ($r = 0.41$) and negatively with the SJFT index ($r = -0.34$), while push-ups showed the highest correlation ($r = 0.46$ with throws; $r = -0.38$ with index, $p < 0.01$). Handgrip strength also correlated moderately with performance ($r \approx 0.31 - 0.36$ with throws; $r \approx -0.21$ to -0.24 with index), with a slightly stronger effect for the left hand. Medicine ball throw distances had the weakest correlations, though still significant, suggesting that isolated upper-body power is less critical than integrated strength and endurance. When analyzed by sex, boys generally showed stronger correlations, especially in medicine ball throws, while girls maintained significant associations mainly in jumps and endurance tests. Overall, results consistently indicated that better neuromuscular fitness was linked to more throws and a lower fatigue index in the SJFT for both sexes.

Tabela 1. Descriptive Analysis of the Sample

Variable	Total Sample (n=271)	Boys (n=182)	Girls (n=89)
Age (years)	14.5 ± 1.7	14.7 ± 1.6	14.1 ± 1.7
Height (cm)	160.2 ± 10.3	163.4 ± 9.8	154.1 ± 9.2
Body mass (kg)	54.7 ± 12.5	57.9 ± 12.3	49.0 ± 10.5
Years of judo practice	3.9 ± 1.8	4.0 ± 1.9	3.8 ± 1.6

Tabela 2. Correlations between neuromuscular test performance and SJFT results (N =271).

a)	Test	b)	SJFT Index	c)	SJFT Total Throws
d)	Seated Medicine Ball Throw (m)	e)	-0.123*	f)	0.133*
g)	Standing Medicine Ball Throw (m)	h)	-0.162**	i)	0.183**
j)	Standing Long Jump (m)	k)	-0.340**	l)	0.414**

m)	Squat Jump (cm)	n)	-0.291**	o)	0.360**
p)	Countermovement Jump (cm)	q)	-0.301**	r)	0.296**
s)	Push-ups (#)	t)	-0.377**	u)	0.461**
v)	Sit-ups (#)	w)	-0.353**	x)	0.386**
y)	Handgrip Strength Right (kg)	z)	-0.206**	aa)	0.306**
bb)	Handgrip Strength Left (kg)	cc)	-0.235**	dd)	0.363**

Significance ** $p < 0.01$, * $p < 0.05$

Tabela 3. Correlations between neuromuscular fitness tests and SJFT outcomes in male and female judokas

Test	Male Index SJFT	Male Total Throws	Female Index SJFT	Female Total Throws
Seated Medicine Ball Throw (m)	-0.075	0.171*	-0.017	-0.009
Standing Medicine Ball Throw (m)	-0.144	0.228**	0.000	0.061
Standing Long Jump (m)	-0.290**	0.424**	-0.336**	0.394
Squat Jump (cm)	-0.288**	0.387**	-0.169*	0.224**
Countermovement Jump (cm)	-0.313**	0.332**	-0.161*	0.172*
Push-ups (#)	-0.369**	0.497**	-0.324	0.345
Sit-ups (#)	-0.326**	0.371**	-0.320	0.357**
Handgrip Strength Right (kg)	-0.162	0.361**	-0.205	0.145
Handgrip Strength Left (kg)	-0.177**	0.376**	-0.288**	0.271**

DISCUSSION

This study confirms that higher neuromuscular fitness is associated with superior SJFT performance in young judokas, meaning that stronger, more powerful, and more enduring athletes execute more throws with lower fatigue. These findings expand prior evidence in judo physiology and emphasize the multifactorial nature of performance.

Lower-body explosive power emerged as a key contributor, with standing long jump and vertical jumps showing the strongest correlations, consistent with Detanico et al. (2020) and Tavares Junior et al. (2023) and supporting the role of leg drive in repeated throwing actions (Arazi et al., 2017). Upper-body power also related to SJFT outcomes, though less strongly, suggesting a secondary role. Handgrip strength, a critical judo-specific attribute, showed moderate associations, reinforcing (Detanico et al., 2018; Kons et al., 2020) who identified grip and jump tests as predictors of SJFT performance.

Muscular endurance was another decisive factor, with push-ups and sit-ups strongly linked to both throws and index, indicating better resistance to fatigue. This aligns with Bouzoualegh et al. (2023), who found endurance and power, not maximal strength as primary determinants of SJFT performance. Moreover, the negative associations with the SJFT index highlight the contribution of aerobic recovery capacity, as shown in previous studies (Tavares Junior et al., 2023)

It is worth noting that the SJFT index incorporates heart rate, so a lower index implies better cardiovascular recovery relative to effort. The negative correlations between our fitness tests and the SJFT index indicate that fitter athletes had lower post-exercise heart rates for a given number of throws. This hints at a better aerobic base. Although we did not measure VO_2max in this study, previous research has shown moderate correlations between SJFT performance and

aerobic capacity in judokas (Detanico *et al.*, 2012; Farzaneh Hesari *et al.*, 2014). Improved aerobic fitness accelerates recovery (*e.g.*, faster phosphocreatine resynthesis and lactate clearance), which could allow youth athletes to sustain high rates of throwing. Therefore, coaches should not neglect aerobic conditioning even as they emphasize strength and power training.

Finally, sex differences were observed, with boys generally showing stronger correlations, likely reflecting maturational effects. Still, significant relationships across both sexes confirm that neuromuscular fitness—strength, power, endurance, and aerobic capacity—is fundamental to judo-specific performance from an early age.

Applications for Training: Judo-specific performance in youth depends on well-rounded neuromuscular fitness. Coaches should combine plyometrics, medicine ball drills, grip exercises, and endurance circuits with technical training to improve both SJFT outcomes and competitive performance (Detanico *et al.*, 2018; Detanico *et al.*, 2020). Regular monitoring with the SJFT can help track fitness adaptations and guide individualized conditioning.

Limitations: This cross-sectional design shows associations but not causality, and factors like aerobic capacity, technique, and motivation were not directly measured. Despite this, the consistent correlations suggest that strength, power, and endurance are key components of youth judo performance, warranting future longitudinal studies.

CONCLUSION

This study shows that neuromuscular fitness is strongly associated with SJFT performance in young judokas. Greater lower- and upper-body power, muscular endurance, and grip strength were linked to more throws and lower fatigue indices, confirming their importance for sport-specific fitness (Detanico *et al.*, 2018). These findings reinforce that comprehensive conditioning during adolescence combining strength, power, endurance, and grip training that provides a clear performance advantage. Simple tests such as the long jump and handgrip can serve as practical monitoring tools, helping coaches identify strengths and weaknesses and guide targeted training to improve both SJFT outcomes and competitive success.

Although the SJFT is primarily considered an intermittent test with a strong glycolytic and sport-specific component, our findings indirectly suggest that neuromuscular variables significantly contribute to its performance outcomes. This reinforces the notion that even tests designed to replicate match intensity are influenced by broader physical qualities such as power, strength, and endurance. Therefore, while the SJFT remains a valuable judo-specific assessment, its results are not solely determined by energy system efficiency but also by an athlete's neuromuscular profile particularly lower-body explosive power, grip strength, and muscular endurance which may enhance their ability to sustain high-frequency throwing efforts.

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EFFECTS OF A 4-WEEK BLOOD FLOW RESTRICTION TRAINING PROGRAMME ON GRIP PERFORMANCE AND PHYSIOLOGICAL CHANGES IN JUDOKA: A PILOT STUDY

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ABSTRACT

This pilot study used a single-group pre–post design to examine the effects of a 4-week blood flow restriction (BFR) training programme on grip performance and muscle oxygenation in elite judoka, aiming to estimate the magnitude of training-related improvements to guide future applied research. Six international-level athletes completed seven grip-specific BFR sessions (~50% arterial occlusion pressure). Hand grip strength (HGS), judogi grip strength test (JGST) performance, and muscle oxygenation (*reactive hyperaemia*) were assessed before and after the intervention. A control group was not included, as this was a small, closely training elite cohort where cross-contamination and expectancy effects would likely occur. Results indicate that small, non-significant improvements were observed in HGS (+1.3%, $p=0.62$) and JGST (+2.1%, $p=0.55$). Muscle oxygenation measures demonstrated substantial changes: SmO₂Rest improved by 6.2% ($p<0.01$), SmO₂Min by 36.4% ($p=0.02$), and SmO₂Max by 2.9% ($p<0.001$), while SmO₂HTR increased by 20.0% ($p=0.04$) indicating a reduced recovery capacity despite improved oxygen utilisation. In summary, a short-term grip-specific BFR programme did not yield significant gains in grip strength but elicited substantial physiological effects within four weeks. These findings suggest that BFR training is associated with rapid muscular changes even in highly trained athletes, with a need for further investigation of its use, both in terms of whether athletes will use such training alongside standard training, and for research to compare improvements against appropriate control data.

Keywords: judo, blood flow restriction, BFR training, grip performance, oxidative capacity

INTRODUCTION

Judo is a high-intensity grappling sport involving throws, hold-downs, and submissions (Franchini *et al.*, 2013). Grip fighting (*kumi-kata*) accounts for ~60% of match effort, as establishing control of the opponent's judogi is crucial for executing attacks and scoring points (Soriano *et al.*, 2019). However, High Grip Strength (HGS) declines across repeated contests (Bonitch-Gongora *et al.*, 2012; Kons *et al.*, 2018), highlighting the importance of grip strength and endurance for performance. Developing effective training methods to target these qualities is therefore of practical value to judokas. Blood flow restriction (BFR) training combines low-load resistance exercise (20–40% 1RM) with partial vascular occlusion, producing adaptations comparable to high-load training ($\geq 70\%$ 1RM) in strength (Gronfeldt *et al.*, 2020), hypertrophy (May *et al.*, 2022), and endurance (de Lemos Muller *et al.*, 2019). Held *et al.* (2023) reported improved grip endurance in climbers after 5 weeks of climbing-specific BFR training which the authors suggested may be due to enhanced muscular adaptations. Given the similarities in gripping demands, these findings may benefit grip performance in judo, but direct evidence is lacking. Accordingly, this pilot study aimed to investigate: (1) the effects of a 4-week BFR training programme on grip strength and endurance in judokas; (2) the physiological responses to BFR training.

METHODS

Research Design

Using a test–retest design, all athletes completed a 4-week grip-specific BFR training block. Performance and physiological responses were assessed one week before and after the intervention at the same time of day (09:00–11:00). A control group was not feasible given the small, integrated elite squad, where training overlap and awareness of group allocation could bias outcomes.

Participants

6 judokas (3 male and 3 female; Age: 19.67 ± 0.82 ; height: 168 ± 8.22 cm) from the British Judo World-Class Performance Programme participated (age 19.67 ± 0.82 years; body mass 68.98 ± 13.01 kg; height 168 ± 8.22 cm) in this study.

Training Programme

The training programme consisted of 7 grip-specific resistance sessions using existing British Judo grip circuits completed over 4-weeks (2 sessions per week). BFR sessions were standardised with each participant maintaining the same individual calibrated arterial occlusion pressure (AOP) for each session. Each training session was completed in ~40 minutes (including setup ~10 minutes, main session ~20 minutes and post-session questionnaires/scales ~10 minutes), BFR cuffs took ~5 minutes to setup (including attachment of the device, app setup and band calibration) and ~2-3 minutes to finalise the session in the app and remove the cuff. Total occlusion time lasted for ~20 minutes, this accounted for ~8% of training time from the athletes training week. Sessions were completed on either a Monday and Wednesday or a Wednesday and Friday which was done either in the morning (11:00) or as the last session of the day (15:00/16:00) to fit within the athletes congested training schedules. A pneumatic cuff (AirBands, Vald, Australia) were applied proximally on the upper arms and calibrated for each participants AOP. AOP was set at 50% for each participant. Training load (sets $\times$ reps $\times$ weight), rating of perceived exertion (RPE), rating of perceived discomfort (RPD), and mood (BRUMS) were monitored throughout.

Testing Protocol

Body mass (Seca, 875, China), stature (Seca, 213, China), body fat percentage (Tanita MC-780, Tanita, Japan) and flexed muscle circumferences (Seca, measuring tape, China) were measured pre-and-post-intervention. A reactive hyperaemia test was conducted for the flexor digitorum superficialis using near infrared spectroscopy (Moxly Monitor, Fortiori Design LLC, USA). After a 3-minute rest, a 5-minute occlusion (~220 mmHg) was conducted followed by a 3-minute recovery was to determine forearm oxidative capacity. Three trials were conducted for each arm using a HGS dynamometer (Takei Hand Grip Dynamometer, A5001, Japan) to assess HGS. The JGST was completed to measure strength-endurance of the forearms (isometric hold time to fatigue- 15-minute rest- dynamic chin-up repetitions to failure, all performed holding a judogi).

Statistical Analysis

Data were reported as mean $\pm$ SD. Normality was assessed with the Shapiro–Wilk test. A paired samples t-test was completed for performance (HGS, JGST) and physiological (SmO_2 variables) outcomes. Significance was set at $p < 0.05$. Analyses were conducted in SPSS (v29.0.2.0, IBM, USA).

RESULTS

Participant characteristics, anthropometric data, grip performance, and muscle oxygenation responses are presented in Tables 1–2 and Figure 1. As Table 1 indicates, overall anthropometric measures remained stable throughout the intervention, although small increases were observed in upper-limb circumferences, with the dominant arm showing the largest percentage increase. These changes, though modest, suggest local muscular adaptation to the grip-specific blood-flow-restriction (BFR) stimulus.

As shown in Table 2, grip performance displayed notable percentage improvements in sport-specific endurance measures. While handgrip strength showed minimal change, the judogi grip strength tests demonstrated moderate increases in both isometric hold time and dynamic repetitions. Although these changes did not reach statistical significance, they represent meaningful practical improvements in grip endurance within a short intervention period, particularly relevant for elite judo performance contexts. Although the threshold is necessarily arbitrary, percentage improvements greater than approximately 8–10% were regarded as practically meaningful in this context, where even small physiological gains can influence competitive performance.

Muscle oxygenation results, illustrated in Figure 1, showed contradictory responses to the training programme. Decreases in SmO_{2Rest} , SmO_{2Min} , and SmO_{2Max} indicated an enhanced oxygen utilisation, whereas an increase in SmO_{2HTR} suggested slower recovery dynamics following training. These findings suggest that a short-term, grip-specific

BFR programme is associated with rapid muscular changes in highly trained athletes, even without statistically significant changes in exercise performance.

Table. 1. Shows participant characteristics and anthropometric data (gender, age, height, BM, BF and muscle circumferences) before (pre-) and after (post-) the intervention.

Variable	Pre (Mean $\pm$ SD)	Post (Mean $\pm$ SD)	p-value	% Change	Interpretation
BM (kg)	68.98 $\pm$ 13.01	69.50 $\pm$ 13.55	0.12	+0.75%	Small I, NS
BF (%)	12.40 $\pm$ 8.83	11.92 $\pm$ 7.96	0.17	-3.9%	Small decrease, NS
Dominant forearm (cm)	28.03 $\pm$ 2.79	28.25 $\pm$ 2.86	0.27	+0.79%	Small I, NS
Non-dominant forearm (cm)	27.67 $\pm$ 3.01	28.00 $\pm$ 2.83	0.09	+1.19%	Small I, NS
Dominant upper arm (cm)	34.17 $\pm$ 3.49	34.67 $\pm$ 3.62	0.04*	+1.46%	Significant increase
Non-dominant upper arm (cm)	33.42 $\pm$ 3.88	33.75 $\pm$ 3.40	0.09	+0.99%	Small I, NS

Data above displayed as mean $\pm$ standard deviation and percentage change. P-value <0.05= significant*, NS= non-significant. M= male, F= female, BM= body-mass, BF= body-fat.

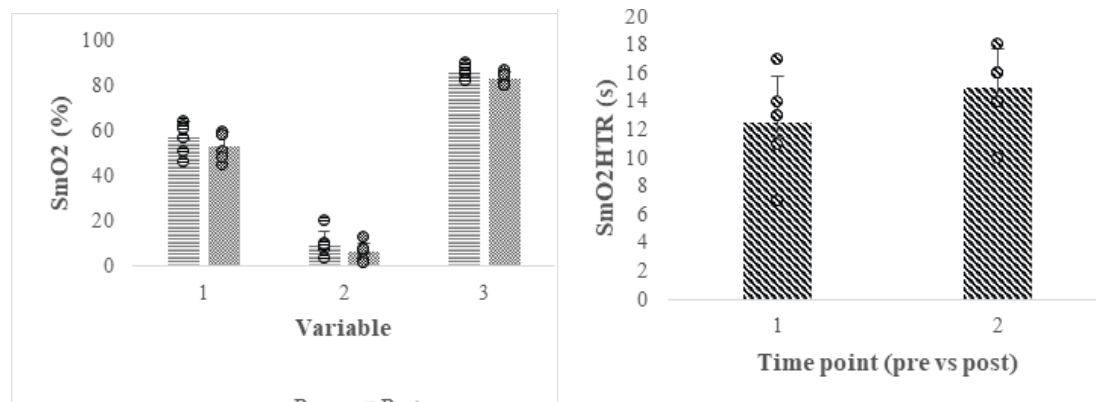
Table.2. Shows grip performance data (HGS, JGST isometric hold and JGST dynamic test) pre-and-post-intervention.

Variable	Pre (Mean $\pm$ SD)	Post (Mean $\pm$ SD)	p-value	% Change	Interpretation
Left HGS (kg)	39.58 $\pm$ 10.57	39.89 $\pm$ 10.16	0.41	+0.78%	Small I, NS
Right HGS (kg)	38.03 $\pm$ 9.96	38.03 $\pm$ 9.30	0.50	0.00%	No change, NS
JGST isometric hold (s)	52.50 $\pm$ 9.69	58.17 $\pm$ 9.75	0.12	+10.8%	Moderate, NS
JGST dynamic (reps)	12.17 $\pm$ 5.57	13.33 $\pm$ 6.80	0.06	+9.5%	Moderate, trend towards significance

Data above displayed as mean $\pm$ standard deviation and percentage change. P-value <0.05= significant*, NS= non-significant. HGS= handgrip strength, JGST= judogi grip strength test.

Muscle oxygenation

Fig.1. Shows muscle oxygenation data pre-and-post-intervention.



Data above displayed as mean $\pm$ standard deviation. P-value <0.05= significant*. SmO2Rest= Resting SmO2, SmO2Min= minimum SmO2, SmO2Max= maximum SmO2, SmO2HTR= SmO2 half-time recovery.

DISCUSSION

Preliminary findings suggest that 4-weeks of BFR training did not improve grip performance in judoka, despite some muscular changes. HGS and JGST results showed no significant improvements, though athletes on an individual-basis demonstrated notable gains, likely reflecting variability in training dose, fatigue, baseline capacity, and responsiveness, consistent with evidence of individual differences in hypoxic training adaptation (Girard *et al.*, 2023). Muscle oxygenation demonstrated interesting findings, with reduced SmO_2min indicating a greater deoxygenation and potential improvements in oxygen extraction, whereas increased SmO_2HTR suggests slower reoxygenation. Similar findings have been reported in climbers, where low-volume BFR training did not further enhance grip performance or alter forearm oxidative capacity (Javorsky *et al.*, 2023), possibly due to an insufficient progression in exercise intensity. Rising RPE and RPD (8 vs 14 and 3 vs 5 in week 1 vs week 4, respectively) scores across the programme also suggest accumulating fatigue which may have influenced results in the current study. Furthermore, more robust changes may be expected after a longer intervention duration (*i.e.* >4 weeks).

A limitation of the present study was the absence of a control group. Although pre-intervention data provided a within-subject comparison, participants were at different phases of their training cycles, making direct comparison with prior data unreliable. Ideally, a matched control group would provide stronger causal inference, but in this small, integrated elite training squad, cross-contamination and expectancy effects would have been unavoidable. Future studies might address this limitation through crossover or matched-case designs to balance ecological validity with experimental control.

CONCLUSION

In summary, a 4-week grip-specific BFR training programme does not appear to be effective for improving grip performance in international-level judoka. Additionally, BFR training may lead to muscular changes within a short-time frame. Further research is warranted to elucidate the exact mechanisms behind BFR training that underpin changes in muscular strength and strength-endurance. Moreover, future studies should consider exploring the efficacy of BFR training on an individual basis in a similar population by conducting a series of case-studies.

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EFFECTS OF CONSECUTIVE SIMULATED JUDO MATCHES ON SINGLE-LEG CMJ, HANDGRIP STRENGTH, BILATERAL INDEX, AND INTERLIMB ASYMMETRY IN YOUNG JUDOKAS

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ABSTRACT

This study investigated the effects of consecutive simulated judo matches on handgrip strength, single-leg countermovement jump (SLCMJ), interlimb asymmetry, and bilateral index (BI) among prepubescent judokas. A total of 14 young athletes (10 girls, 4 boys; age: 11.8 ± 1.0 years; body mass: 44.1 ± 11.1 kg; height: 149.9 ± 7.3 cm; training experience: 3.9 ± 0.3 years) participated in the study. Handgrip strength and SLCMJ were measured before and after three consecutive simulated judo matches. Results revealed no significant changes in handgrip strength, SLCMJ, interlimb asymmetry, or BI ($p > 0.05$). These findings suggest that consecutive simulated judo matches may not induce considerable fatigue in prepubescent judokas, highlighting the potential resilience of younger athletes to match-induced performance decrements.

Keywords: young judokas, handgrip strength, asymmetry, countermovement jump, bilateral index.

INTRODUCTION

Grip performance is a critical skill in judo, as judokas must grasp their opponents quickly and forcefully before executing throws (Courel et al., 2014). The dominant hand plays a key role in initiating attacks and establishing the first grip, and the preferred stance is often associated with the dominant side (Simenko et al., 2017). For instance, right-dominant judokas typically use the left leg as the supporting leg and the right leg for offensive movements (Šimenko et al., 2016). Consequently, asymmetries may develop in the dominant limbs due to repetitive loading and higher workload demands (Courel et al., 2014; Simenko et al., 2017). Such asymmetries can lead to muscular imbalances (Šimenko et al., 2016).

Judokas often participate in multiple consecutive matches on competition days (Kons et al., 2020). These consecutive matches can cause fatigue in both upper and lower extremities (Campos et al., 2025), potentially impairing handgrip strength and vertical jump performance (Kons et al., 2020). Lower-limb asymmetry has been shown to negatively affect judo-specific performance (Fukuda et al., 2018; Kons et al., 2020a). Furthermore, consecutive matches may increase interlimb asymmetry (Kons et al., 2021). Therefore, it is important to examine whether such asymmetries influence sport-specific performance or pose injury risks. Although asymmetries have been associated with both performance outcomes (Kons et al., 2020b) and injury risk (Helme et al., 2021), there is limited research addressing these changes during consecutive matches in prepubescent athletes. Accordingly, the present study aimed to evaluate the effects of consecutive simulated judo matches on unilateral performance, interlimb asymmetry, and bilateral deficit in prepubescent judokas.

METHODS

Participants

The study included 14 young judokas (10 girls, 4 boys) with a mean age of 11.8 ± 1.0 years, body mass of 44.1 ± 11.1 kg, height of 149.9 ± 7.3 cm, and training experience of 3.9 ± 0.3 years, all holding at least a green belt. Athletes with a history of major injuries, surgeries, or conditions affecting performance within the last year were excluded. Participants were instructed to maintain their normal diet and refrain from using any supplements 48 hours before testing. Consent

was obtained from the legal representatives prior to the study. All procedures were carried out according to the Helsinki Declaration.

Study Design

Asymmetry and bilateral deficit levels were calculated based on maximum isometric handgrip strength and single-leg CMJ (SLCMJ) performances. All participants performed three SLCMJ trials, three bilateral handgrip tests, and three maximal handgrip tests for each arm before and after simulated matches. Simulated judo matches followed the official competition duration for the age group (3 minutes).

Simulated Judo Matches

Before matches, athletes completed a 10-minute warm-up including judo-specific movements. They then participated in three 3-minute simulated matches, separated by 10-minute rest intervals. Matches were continued if an ippon was scored, ensuring the total duration. Athletes were matched against opponents within their weight category or one weight category above or below their own.

Single-Leg Countermovement Jump (SLCMJ)

Following warm-up, athletes performed three submaximal jumps for each leg as familiarization, then rested for 3 minutes. They then completed three maximal SLCMJ trials with 1-minute intervals. Post-match testing followed the same protocol. The mean of the three attempts for each leg was used.

Handgrip Strength Measurement

Handgrip strength was assessed bilaterally and unilaterally using a Takei dynamometer (Tokyo, Japan). After a sport-specific warm-up and three submaximal grips, participants performed three maximal trials per arm, each lasting 3–5 seconds. Measurements were taken with athletes standing, shoulders neutral, elbows at 135° flexion, and wrists neutral (Kattel et al., 1996).

Asymmetry and Bilateral Index

Interlimb asymmetry was calculated using the formula by Kons et al. (2021), expressed as the percentage difference between stronger and weaker limbs. The Bilateral Index (BI) was calculated as the ratio of bilateral to unilateral handgrip strength values (Howard & Enoka, 1991). Positive BI values indicated bilateral facilitation, while negative values indicated a bilateral deficit.

Statistical Analysis

Data were analyzed using JASP (0.19.1.0, The Netherlands). The data normality was checked with Shapiro Wilk Test. Athletes' performance in handgrip strength (HGS) and single leg CMJ performance and bilateral asymmetry were compared using Paired Sample T Test. Effect size was classified using Cohen's d. Significance was set at $p < 0.05$.

RESULTS

Athletes' HGS and single leg CMJ did not differ before and after a simulated judo match ($p > 0.05$) The data can be seen in Table 1.

Table 1. Handgrip strength and single-leg CMJ performance before and after simulated judo matches

Variables	Pre-Test		Post-Test		p	d
	X ± SD	95% CI(Up-per-lover)	X ± SD	95% CI(Up-per-lover)		
Right leg CMJ (cm)	18.59 ± 3.35	16.65-20.52	19.64 ± 5.06	16.72-22.56	0.91	-0.38
Left leg CMJ (cm)	18.97 ± 4.21	16.54-21.4	19.68 ± 5.96	16.24-23.12	0.84	-0.28

Bilateral hand grip (kg)	38.49 ±8.03	33.86-43.13	38.29 ±9.25	32.95-43.63	0.41	0.06
Right handgrip (kg)	19.70 ±4.96	16.84-22.57	20.13 ±4.27	17.67-22.59	0.81	-0.24
Left handgrip (kg)	19.28 ±4.07	16.93-21.63	18.58 ±4.06	16.23-20.92	0.56	0.45
Dominant leg (cm)	19.76 ±3.97	17.46-22.05	20.68 ±5.42	17.55-23.81	0.93	-0.42
Nondominant leg (cm)	17.80 ±3.34	15.87-19.72	18.64 ±5.43	15.51-21.78	0.85	-0.29

* $p < 0.05$, $\bar{X} \pm SD$; Mean $\pm$ Standard Deviation, CI: Confidence Interval of means.

There was no significant difference between interlimb asymmetry and bilateral index percentages before and after the simulated judo match ($p > 0.05$). The data can be seen in Table 2.

Table 2. Changes in interlimb asymmetry and bilateral index before and after simulated judo matches

Variables	Pre-Test		Post-Test		p	d
	$\bar{X} \pm SD$	95% CI(Up-per-lover)	$\bar{X} \pm SD$	95% CI(Up-per-lover)		
Interlimb asymmetry percentage (%)	9.51 ± 6.61	5.69-13.32	10.30 ± 7.90	5.74-14.86	0.63	-0.09
Bilateral Index (%)	-0.63 ± 7.84	-5.16-3.90	-1.58 ± 6.62	-5.40-2.24	0.38	0.08

* $p < 0.05$, $\bar{X} \pm SD$; Mean $\pm$ Standard Deviation, CI: Confidence Interval of means.

DISCUSSION AND CONCLUSION

The main finding of this study is that consecutive simulated judo matches did not significantly affect single-leg CMJ performance, maximal handgrip strength, interlimb asymmetry, or BI in prepubescent judokas. This suggests that younger athletes may have limited fatigue-related performance decrements compared to older or more experienced judokas.

Our findings align with those of Turnes et al. (2022), who reported that bilateral deficit was observed mainly in advanced-level judokas, while less experienced athletes did not show significant differences. Similarly, Fukuda et al. (2018) indicated that differences in grip strength tend to increase with age and training experience. The absence of significant changes in the present study may thus be related to the young age and relatively limited experience of the participants.

Conversely, Kons et al. (2018, 2021) and Carballeira et al. (2008) reported decline in handgrip strength during consecutive matches in older judokas, with greater declines observed in official competitions. These discrepancies may reflect differences in psychological stress, motivation, and competition intensity between simulated and real matches. Future research should therefore explore these variables under actual competition conditions, across larger samples and different age categories.

In conclusion, consecutive simulated judo matches did not negatively impact handgrip strength, jump performance, or asymmetry in young judokas. Monitoring asymmetry and bilateral deficit remains important in training programs, particularly as athletes progress to higher levels of competition.

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PERFORMANCE ASSESSMENT OF ELITE BRAZILIAN JUDO ATHLETES WITH VISUAL IMPAIRMENTS: A ORIGIN OF IMPAIRMENT ANALYSIS

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INTRODUCTION

Judo, an Olympic and Paralympic sport competed under similar rules for both male and female athletes (Kons et al., 2018a), characterized by intermittent activity including the performance of a wide range of high-intensity technical-tactical actions, often interrupted by brief pauses (Miarka et al., 2012; Gutierrez-Santiago et al., 2022). To be successful, judo athletes' performance depends not only on technical-tactical proficiency but also on physical fitness (Franchini et al., 2013; Miarka et al., 2012; Kons et al., 2018b). During competitions, athletes engage their upper limbs in constant pulling and pushing movements to maintain a strong grip on the judogi and set up attacks (Franchini et al., 2011), while their lower limbs perform continuous power actions to support movement and control (Detanico et al., 2012; Kons et al., 2018b). These factors are present in both conventional judo and for athletes with visual impairments, taking into account the unique nature of the sport in each context (Franchini et al., 2011; Kons et al., 2025).

In the context of judo for athletes with visual impairments, performance is particularly complex due to the significant influence of various factors such as visual acuity and field of vision during matches (Krabben et al., 2020; Krabben et al., 2021), as well as aspects related to the origin of the impairment (e.g., *acquired vs. congenital*) (Kons et al., 2023a). In this context, few investigations have focused on comparing the origin of impairment and sex in relation to performance in high-level judo athletes with visual impairments (Kons et al., 2025). For instance, Kons et al. (2023) explored the performance of athletes with visual impairments using the adapted Special Judo Fitness Test (*specific judo tests*) and found no significant differences between high-level athletes with acquired and congenital impairments.

Given the limited research comparing performance across impairment origin and sex in high-level judo athletes with visual impairments, this study aimed to describe the physical and competitive performance of these athletes, considering the origin of impairment (*acquired vs. congenital*). The study also sought to compare these aspects across the groups to identify their profiles and respective differences. It was hypothesized that no significant differences would emerge based on the origin of impairment, as existing literature suggests that both acquired and congenital impairment groups develop comparable skills and adapt effectively over time, particularly at high levels of competition, where technical-tactical proficiency and physical fitness tend to outweigh the influence of impairment origin (Kons et al., 2023a; Kons & Patatas, 2023).

METHODS

Research Design

In a cross-sectional study design, the physical and competitive performances of elite Brazilian judo athletes with visual impairments were assessed considering sex and the origin of impairments factors. Data collection occurred during a training camp held three months before the Paris 2024 Paralympic Games, ensuring that the performance measures aligned with the athletes' preparation for the upcoming competition. Additionally, competitive performance data was extracted from the Paris 2024 Paralympic Games results book.

Participants

Thirteen judo athletes with visual impairment participated in this study (*Males* = 7; *age* = 28.2 ± 8.1 years old; *body mass* = 95.0 ± 33.1 kg; *height* = 176 ± 8 cm; and *years of judo experience* = 13.2 ± 5.3 years) and (*Females* = 6; *age* = 29.1 ± 7.8 years old; *body mass* = 73.8 ± 27.0 kg; *height* = 162 ± 8 cm; and *years of judo experience* = 11.6 ± 4.7). Regarding the origin of impairment, six athletes had acquired impairments, with an average age of 29.1 ± 7.8 years, body mass of 91.3 ± 38.6 kg, height of 169 ± 11 cm, and an average of 12.1 ± 6.9 years of judo experience. Seven athletes, categorized as congenital, had an average age of 28.2 ± 8.1 years, body mass of 80.0 ± 25.2 kg, height of 170 ± 11 cm, and an average of 12.8 ± 3.4 years of judo experience.

Procedures

During a training camp three months before the Paris 2024 Paralympic Games, athletes underwent physical tests including maximal isometric handgrip strength (*dominant side*), medicine ball throw, and countermovement jump, each preceded by a 15-minute warm-up and separated by 30-minute rests. Three months later, their competitive performance at the Games was analyzed using competition results, focusing on techniques used, match outcomes, win ratio, scoring index, and technical variability in standing and groundwork. This analysis complemented the earlier physical assessments.

Physical Tests

Handgrip strength was measured using a dynamometer (*Carci, SH 5001*) with three maximal efforts; the medicine ball throw followed Fukuda (2019), with athletes seated against a wall performing three maximal throws of a 3 kg ball; and countermovement jump (*CMJ*) was assessed on a jump mat (*CEFISE, Brazil*) with three maximal jumps, all using the average value for analysis.

Competitive performance analysis

Competitive performance was analyzed from the Paris 2024 Paralympic Games results, including standing techniques (*leg/foot, hip, hand/arm, and sacrifice throws*) and groundwork techniques (*pin, armlock, and choke*) (Daigo, 2005). For each athlete, we assessed win ratio, scoring index, standing technical variability, and groundwork technical variability, all calculated based on the number of executed techniques per match.

Statistical analysis

All analyses were performed using JASP software (*version 0.11.1, JASP Team, University of Amsterdam, Netherlands*). Data are reported as mean (*M*) and standard deviation (*SD*). We also tested the proportion of athletes of each sex and origin of impairment, using the Chi-square test, and found no significant association indicating no risk of bias when analyzing by groups. Independent t-test was used to compare the physical performance tests and competitive performance between origin of impairment was used to interpret the results of the t-test, considering: 0.0–0.25 as trivial, 0.21–0.60 as small, 0.61–1.2 as moderate, 1.21–2.0 as large, and $2.1 > 4.5$ as very large (*Hedges' g*) (Cohen, 1988).

RESULTS

Table 1 compares physical tests and competitive performance based on the origin of impairment (*acquired and congenital*) for judo athletes with visual impairments. No differences were found in either physical tests or competitive performance between the two groups. Finally, no correlation was found considering physical tests results and competitive performance ($r = 0.10$ to 0.28 ; $p > 0.05$ [*small to moderate effects*])

Table 1. Comparison of Physical tests and competitive performance according to the origin of impairment (acquired and congenital) for judo athletes with visual impairments.

Physical Tests	Acquired	Congenital	p	Hedges' g
Handgrip strength (kgf)	82.3 $\pm$ 24.2	73.2 $\pm$ 13.0	0.52	0.33 (small)
Countermovement jump (cm)	33.3 $\pm$ 9.2	34.8 $\pm$ 10.1	0.78	0.14 (trivial)
Medicine Ball throw (m)	4.5 $\pm$ 1.1	4.5 $\pm$ 1.2	0.97	0.02 (trivial)

Competitive performance				
Win ratio	0.50 ± 0.3	0.69 ± 0.2	0.25	0.61 (moderate)
Scoring Index	0.45 ± 0.4	0.71 ± 0.4	0.31	0.54 (small)
Technique ability standing	0.36 ± 0.3	0.50 ± 0.2	0.39	0.46 (small)
Technique ability groundwork	0.30 ± 0.2	0.28 ± 0.2	0.88	0.07 (trivial)

In the table 1 compares physical tests and competitive performance by sex (*male and female*) for judo athletes with visual impairments. Significant differences were observed in the physical tests, with higher values for male and female athletes. However, no differences were found in competitive performance between the two groups.

Table 2. Comparison of physical tests and competitive performance according to sex (male and female) for judo athletes with visual impairments

Physical Tests	Male	Female	p	Hedges' g
Handgrip strength (kgf)	89.7 ± 24.4	63.1 ± 16.0	0.045	1.17 (moderate)
Countermovement jump (cm)	38.7 ± 9.7	28.7 ± 5.5	0.048	1.14 (moderate)
Medicine Ball throw (m)	5.4 ± 0.6	3.5 ± 0.5	<0.001	2.99 (very large)
Competitive performance				
Win ratio	0.57 ± 0.3	0.64 ± 0.2	0.69	0.20 (trivial)
Scoring Index	0.53 ± 0.5	0.66 ± 0.3	0.61	0.27 (small)
Technique ability standing	0.35 ± 0.3	0.52 ± 0.1	0.29	0.57 (small)
Technique ability groundwork	0.33 ± 0.2	0.26 ± 0.2	0.61	0.26 (small)

DISCUSSION

The present study aimed to describe the physical and competitive performances of elite judo athletes, considering sex (*male vs. female*) and the origin of impairment (*acquired vs. congenital*) and their possible relationships. The hypothesis was partially confirmed, as significant differences were found only in physical tests (*no difference in competitive performance*), with male judo athletes demonstrating higher values for all tests than female judo athletes with visual impairments. However, no significant differences were observed based on the origin of impairment in terms of competitive and physical performance aspects, as expected based on the respective investigation (Kons *et al.*, 2023a).

No significant differences were observed in physical tests or competitive performance across the origin of impairment groups. This suggests that, regardless of the origin of impairment (*e.g., acquired or congenital*), judo athletes with visual impairments demonstrated similar results in both physical tests and competitive performance. Exploring the relationship between the origin of impairment and performance indicators is crucial (Kons & Patatas, 2023), particularly due to the unique characteristics developed through long-term training aspects (Denghansai *et al.*, 2022). These characteristics may be influenced by the timing of when athletes acquired their impairments, which in turn can affect various aspects of performance in other paralympic modalities (Lopes-Silva *et al.*, 2023; Le Toquin *et al.*, 2021). However, in complex sports such as judo, these factors do not appear to significantly influence specific performance outcomes (Kons & Patatas, 2023). This may help to explain the results of this study, particularly considering the constant dynamic interaction between athletes, which becomes even more intricate due to the lack of vision (Krabben *et al.*, 2019). Such complexities may account for the absence of differences in these performance aspects.

The maximal handgrip strength, countermovement jump, and medicine ball throws demonstrated higher values for male athletes compared to the female groups. This result is expected, as biological characteristics typically contribute to differences in physical performance between males and females (Detanico & Kons, 2023). Factors such as a greater muscle mass, higher testosterone levels, and differences in muscle fiber composition tend to enhance strength and power in male judo athletes (Franchini et al., 2011; Franchini et al., 2013; Gutierrez-Santiago et al., 2022). These physiological attributes often lead to males exhibiting superior performance in activities requiring strength and explosive power, like handgrip strength, jumps, and throws (Kons et al., 2021; Detanico & Kons, 2023).

CONCLUSIONS

In conclusion, this study found that male judo athletes with visual impairments preparing for the Paris 2024 Paralympic Games showed higher performance in all physical tests, compared to female athletes. However, no significant differences were observed in terms of competitive performance between the sexes and the origin of impairment, suggesting that the type of visual impairment does not significantly influence either physical or competitive performance.

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ASSESSMENT OF THE EFFECTIVENESS OF POLICE TRAINING AND ELEMENTS OF JUDO

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ABSTRACT

High level of motor skills and motor abilities are essential for the successful handling of police officers in stressful situations. The aim of this paper was to compare the performance in motor tasks of students who completed the police program in which the elements of judo and police self-defense dominate. The convenient sample of respondents included 57 male students of the Polytechnic of Criminology and Public Security (VKJS) (*part-time students of 1 year of study and part-time students of 2 years of study*). One group of students finished class Police physical training¹ and Police physical training 2 while others did not participate in it. Results showed that students which participated in combat sport class had greater results in pull-up test while no changes were observed in standing long jump, sit-up and max repetition bench press with 70% 1RM. Combat training within the general population has demonstrated effectiveness in promoting the specific development of upper-body strength, as reflected by an increased number of pull-ups. Therefore, combat sport training can be considered a valuable segment of the physical training of police officers.

Keywords: *police training, motor abilities, combat sport*

INTRODUCTION

The martial arts program for police officers is specific because it is saturated with the techniques of various martial arts (*judo, karate, aikido, boxing, wrestling*). Judo is one of basis of police self-defense for members of the army and police. Any use of physical force by a police officer is demanding and specific because it is a direct action of a police officer with the force of his own body towards another person and the highest level of professionalism and situational awareness is expected from him (*Jozić et al., 2023*). The goal of police training, adoption of the element of martial sports, is to create prerequisites for the professional performance of police tasks, which requires knowledge of the handling of those martial arts that undoubtedly do not lead to physical injury (*elements of judo, elements of karate, police self-defense*). The elements of judo training and police self-defense are high-quality and safe educational instruments with a very high value content, which can and should serve as a tool for quality integral formation of people. Adoption of judo fall techniques and defense against throwing techniques can help eliminate or significantly reduce injuries caused by different falls and of course different attacks. The elements of judo as important parts of police self-defense are suitable for improving that knowledge of fighting, as well as basic and advanced elements of police tactics that require prompt, sudden and fast situational handling through control and implementation of apprehension measures. Of course, the performance of elements of judo, police self-defense, depends on the level of anthropological characteristics of the police officers themselves. Judo training, especially fighting (*randori*), will also affect the anthropological characteristics of police officers, such as strength, power and balance, essential for the execution of all those elements for riot control, whether it is done through individual or collective action in highly stressful situations.

METHODS

The research was conducted on a convenient sample of two groups of part-time students of the Polytechnic of Criminology and Public Security (VKJS), a total of 57 male students (*24 first year students and 33 second year students*). Second year students during former school year participated in Police physical training 1 which consists mostly of elements of karate (*zuki, uraken, shuto, empi*), blocks (*age uke, soto uke, uchi uke, gedan barai*) and leg kicks (*mae geri, yoko geri, mawashi geri, ushiro geri*) (*Oyama, 1976; Pupovac, 2000; Jozić, 2002*). Police Physical Training 2 consists mostly of judo throwing techniques (*osoto-gari, o-goshi, tai-otoshi*) (*Sertić and Segedi, 2013*) as well as basic judo falls and self-defense falls (*Zempo, Kaiten Ukemi, Ushiro Ukemi, Yoko Ukemi, "judo fall into bridge"*) (*Tokarski, 2012; Sertić and Segedi, 2013;*

Sertić and Segedi, 2015; DelCastillo-Andrés & Toronjo-Hornillo, 2019). It consists also of elements of police self-defense, apprehension tactics, defense against unarmed and armed attackers (Kudo, 1976; Lucić and Gržeta, 2007).

Students participated in total of 60 school hours (30 hours Police physical training 1 and 30 hours of Police physical training 2) during academic year. Each class consisted of warm-up exercises after which major part was acquisition and practice of techniques followed up with situational drills.

Variables

In assessment of motor skill of VKJS students, the following motor tests were used: standing long jump (SLJ) (Jukić et al., 2008; Jozić, 2020), Sit-ups in 2 minutes (SUP), pull-ups on the bar (PUP) and a test for assessment of the repetitive strength of upper body, bench press with 70% body weight (BP) (Jukić et al., 2008; Jozić, 2020).

Statistics

Descriptive statistics of the variables used to assess the motor skills of students were calculated. Using the t-test for independent samples, the differences between first- and second-year students of the Criminology study were determined. The data collected were processed with the statistical package Statistica for Windows ver. 13.4.

RESULTS

Table 1. Descriptive statistics for group of first year students

Variable	N	Mean	Min	Max	Range	SD
SLJ	24	223,00	170,00	270,00	100,00	24,41
SUP	24	54,91	24,00	81,00	57,00	15,31
PUP	24	6,58	0,00	20,00	20,00	5,36
BP	24	15,71	3,00	30,00	27,00	7,89

Legend: SLJ- standing long jump; SUP- sit-ups; PUP-Pullups; BP- Bench press

Table 2. Descriptive statistics for group of second year students

Variable	N	Mean	Min	Max	Range	SD
SLJ	33	224,39	190,00	265,00	75,00	19,89
SUP	33	49,06	30,00	60,00	30,00	8,21
PUP	33	10,03	2,00	23,00	21,00	6,28
BP	33	15,49	5,00	35,00	30,00	6,89

Legend: SLJ- standing long jump; SUP- sit-ups; PUP-Pullups; BP- Bench press

Table 1 and table 2 present descriptive values for all variables. Similar values can be observed for both groups except pull up values. Group 1 consisted of 24 participants while group 2 consisted of 33 participants.

Table 3. Results of t test for independent groups

Variable	Mean 1	Mean 2	t-value	df	p
SLJ	222,50	224,39	-0,32	55	0,75
SUP	54,92	49,06	1,86	55	0,07
PUP	6,58	10,03	-2,17	55	0,03
BP	15,71	15,48	0,11	55	0,91

Legend: SLJ- standing long jump; SUP- sit-ups; PUP-Pullups; BP- Bench press

Result of t test for independent groups indicate statistically significant differences for variable PUP (*pull ups*). For all other variables no statistically significant differences can be observed.

DISCUSSION

The results of this research showed that after the combat sport class, there was a significant improvement only in the variable of performed pull-ups, while in the other tests: standing long jump, sit-ups and bench press no statistically significant change was recorded. Such results indicate that combat sport teaching, within the program implemented in this research, selectively affects certain components of motor abilities.

Differences in pull-up number between group that finished class of combat sport ($10,03 \pm 6,28$) and the group that did not participate in combat sport class ($6,58 \pm 5,36$) are significant and show practical improvement not just statistical change. Few papers focused on effect of judo training on motor abilities in general population. One research reported improvements in explosive strength, but it included children aged 7–12-year-old who participated in a 12-month judo program (Demirel, 2011). Other research included intellectually disabled people who performed judo program for eight weeks and reported improvements in sit-ups, sit and reach, and standing long jump (Masleša, Videmšek & Karpljuk, 2012). One research included 20 male university students which participated in 8-week judo class. Results indicated improvements in standing long jump, sit-ups, and sit and reach tests (Mohammed, Mohammed & Choi, Hong Jun, 2017).

This research also included standing long jump and sit-up test, but no changes were observed in these tests. Combat classes can have different training approaches which may result in different outcomes. Increase in pull-up number can be explained by effect of specific demands of judo training which include great number of pulling and holding of training partner. During execution of throwing techniques, grip fighting and different specific exercises with training partner, upper body muscles are activated, especially back muscles as well as arm muscles such as biceps or forearm muscles.

On the other hand, although every throwing technique requires lower body power, combat sport classes may not include great volume of targeted plyometric or maximal-explosive exercises that would stimulate the development of this ability. Similarly, sit-ups as an indicator of repetitive trunk strength did not improve significantly, which may indicate that the loads during combat sport classes were not sufficient in intensity or volume to cause adaptations in that muscle group. Although practicing great number of throwing techniques as well kicks and punches with partner may cause greater trunk strength and stability there are few motions of trunk flexion like in sit-up test which may be the reason why there is lack of progress.

CONCLUSION

These findings are consistent with earlier research that points out that martial arts develop specific forms of strength, coordination and balance, but not necessarily all aspects of general motor abilities. Therefore, combat sport can be considered a valuable segment of the physical training of police officers, especially for strengthening the upper body, specific grappling strength and psychophysical endurance.

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THE EFFECT OF A SHORT-TERM TEACHING PROGRAM ON THE MOTOR SKILLS OF YOUNG JUDOKAS – A PILOT STUDY

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ABSTRACT

This study examined the effectiveness of a short-term teaching program focused on manipulative skills in children practicing judo. A total of 12 young judokas participated in this pilot study. The participants were divided into a control and an experimental group and were assessed using the BOT-2 (*short form*) and TGMD-2 (*manipulative skills subtest*) test batteries. Following the initial testing, the experimental group took part in a two-week object manipulation program. The program included five different ball exercises, comprising a total of 160 one-handed (*with both dominant and non-dominant hands*) and two-handed ball throws. The BOT-2 results showed that children in both groups improved their motor abilities between the first and second measurement. On the TGMD-2 test, the experimental group demonstrated improvement. The findings suggest that the program was effective; however, given the small sample size, the results should be interpreted with caution.

Keywords: object-control skills, BOT-2, TGMD-2, motor learning, children.

INTRODUCTION

Judo develops a wide range of motor abilities and has a positive impact on physical health, emotional stability, and social skills of an individual (Miarka et al., 2012). Despite its comprehensiveness, judo training takes place in a specific environment—barefoot and with minimal use of equipment. The acquisition of locomotor and manipulative motor skills is crucial in childhood, as it forms the foundation for physical literacy and the development of motor abilities and later participation in various sports activities (Malina, Bouchard & Bar-Or, 2004). Manipulative motor skills refer to the ability to control different objects with the body, primarily using the hands and feet, through actions such as throwing, catching, striking, dribbling, and rolling a ball. Although object manipulation is classified as a biotic motor skill, it is underrepresented in judo training, as it is not considered a key determinant of success in judo. Nevertheless, manipulative exercises can be beneficial at an early age, as they help develop coordination and contribute to overall physical development. Previous research on the effects of various exercise and teaching methods has demonstrated the effectiveness of different interventions for improving children's manipulative skills. An eight-week bilateral coordination intervention significantly improved children's competence in manipulative skills, particularly in dribbling, passing, and catching a ball in football and basketball (Chen et al., 2021). Similar study showed that an intervention involving ball games (tennis, football, basketball) improved bilateral coordination, balance, and fine motor integration (Petrušić et al., 2023). Positive effects on catching and striking (measured with *Test of gross motor development*) were found after motor skill programs such as BRAINballs (Gombocz et al., 2020), CHAMP and T-SKIP among children (Robinson et al., 2012; Logan, 2014). McKenzie and colleagues found positive effects of physical education classes on manipulative skills (e.g., throwing, catching) in children (McKenzie et al., 1998). Supriadi et al. (2022) conducted a study with elementary school children and determined effectiveness of a special "ball thrower learning device" in teaching manipulative skills. Although research indicates positive effects of programs designed to teach manipulative skills, there is still a lack of studies involving young athletes within structured training processes. Therefore, the aim of this study is to determine changes in manipulative and motor skills following a short-term object manipulation teaching program among young judo athletes aged 8–10 years.

METHODS

The study was conducted on 12 participants (7 boys and 5 girls), all members of a Croatian judo club. The participants were children aged 9.4 ± 1.05 years who had been practicing judo for 2 ± 0.9 years. Parents provided written informed consent for their child's participation in the study. The research was approved by the Ethics Committee of the Faculty of Kinesiology under approval number 8/2025. The children were divided into a control group and an experimental group.

To assess motor skills, the BOT-2 and TGMD-2 test batteries were used. The short version of the BOT-2 (*Bruininks–Oseretsky Test of Motor Proficiency, Second Edition*) consists of 14 subtests assessing fine motor skills, bilateral coordination, balance, speed and agility, upper-limb coordination, and strength. Standardized scores, corrected for age and sex, were calculated according to the instrument's protocol. The TGMD-2 (*Test of Gross Motor Development – 2nd Edition*; Ulrich, 2000) was also used. This battery includes 12 tests divided into two subgroups and is designed to assess fundamental motor skills in children aged 3–10 years. The subset of manipulative skill tests was used in this study, including striking a baseball, dribbling, catching, kicking, overhand throwing, and rolling a ball. Each skill was scored, and the final variable represented the total standardized score in manipulative motor skills. The initial measurement was conducted during the first week, and the final measurement took place in the last (*fourth*) week. After two weeks of the experimental program, participants underwent post-testing using the same instruments. The teaching program lasted two weeks and included four training sessions. During each session, following the warm-up, the experimental group performed ball exercises focused on throwing and catching. Exercises included: a) Throwing a ball with one hand (*basic throw*) – 5 repetitions with each hand; b) Overhead throw from the shoulder (*similar to shot put*) – 5 repetitions with each hand; c) Two-hand side throw (*rugby-style*) – 5 repetitions per side; d) Rolling a ball from a kneeling position – 5 repetitions with each hand and e) Catching exercises included catching the ball and aiming at a target. After completing each task, the children received corrective feedback such as “Elbow up,” “Left/right foot forward,” or “Aim with the other hand.” The instructional program, which focused on ball-throwing exercises aimed at a target, was conducted after the warm-up and lasted approximately 20–25 minutes per session, followed by standard judo technical training. In total, 160 repetitions were performed using both arms, executed unilaterally and bilaterally. The control group followed regular judo training sessions without any additional exercises.

Data were analyzed using Statistica 13.2 software (*StatSoft, Inc., Tulsa, OK, USA*). Descriptive statistics were used to analyze the basic data, including arithmetic mean, standard deviation, frequency distribution, and individual results.

RESULTS

In the TGMD-2 subtest, the mean score for the entire sample of children was 9.83 ± 3.1 , which falls within the “Average” category according to normative ranges (Ulrich, 2000; Bruininks & Bruininks, 2005). In the BOT-2 test, participants achieved a mean score of 46.93 ± 8.29 , also classified as “Average.” In the TGMD-2 test, participants in the control group achieved an average score of 11 ± 3.74 in the first measurement and a slightly lower score of 9.75 ± 2.87 in the second measurement. The experimental group obtained an average score of 9.25 ± 2.82 in the first measurement and 11.63 ± 2.39 in the second measurement (*Figure 1*). Analysis of frequencies in proficiency categories showed that, in the experimental group, one child progressed from the “Below Average” to the “Average” category, and another from the “Average” to the “Above Average” category, whereas the distribution in the control group remained largely unchanged. Both the control and experimental groups showed improvement in the BOT-2 test indicating that teaching program did not affect their results. The experimental group achieved an average score of 52.38 ± 5.88 in the first measurement and 54.86 ± 6.69 in the second measurement.

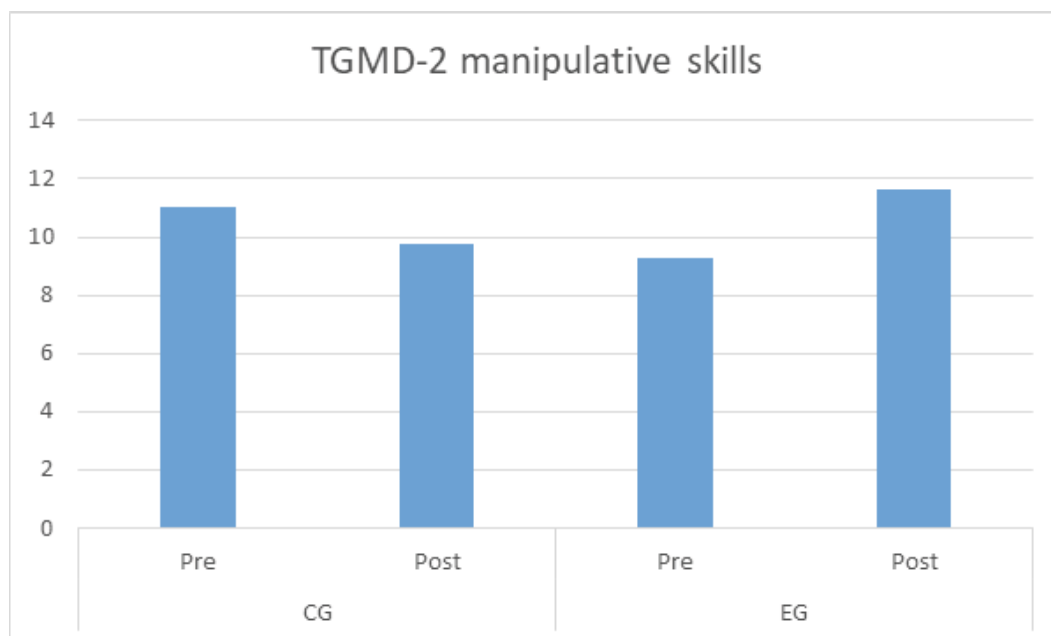


Figure 1. Comparison of mean standardized scores between the control and experimental groups in the first and second measurements.

DISCUSSION

The main findings of this study indicate progress in manipulative skills among the experimental group, but not in overall motor abilities, following the motor teaching program. These results were expected, given that the applied program was specifically designed to teach manipulative skills. Despite its short duration, the program positively affected manipulative skills, as expected. Longer exercise programs, lasting eight or more weeks, as shown in previous studies, would likely produce broader improvements not only in manipulative skills but also in other motor skills and abilities due to prolonged exposure to stimuli. Nevertheless, with quality feedback and the short-term application of teaching content that is not typically part of judo training, it is possible to enhance children's manipulative skills. Based on these results, such short programs can be recommended, although with certain limitations, since the retention effect—i.e., how long the acquired skills are maintained after training cessation—was not examined. The results of this study partially differ from those reported by Karachle et al. (2017), where a six-month recreational gymnastics program led to significant improvements in the BOT-2 test, including coordination, balance, and manual dexterity, which can be attributed to the longer duration of the intervention. Stuhr et al. (2025) reported that even a four-week program focused on developing manual dexterity resulted in significant improvement in the BOT-2 manual dexterity subtest, with a greater proportion of children showing notable progress compared to the control group. Comparing these findings with the present study suggests that both the type and duration of the intervention play a crucial role in achieving significant improvements. The TGMD-2 results indicate that the program implemented in the experimental group had a positive effect on the development of manipulative motor skills. Although these findings suggest the program's effectiveness, they should be interpreted with caution due to the small sample size. Similar results were reported by Donath et al. (2015) in their study conducted in Swiss schools on children aged 7–10 years. Their program, which was integrated into physical education classes and emphasized manipulative skills (*e.g., throwing, striking, and catching*), led to significant improvements in these abilities as measured by the TGMD-2 test, compared to the control group that followed the standard curriculum. The findings of the present study are consistent with these results, as improvements in motor skills were also observed among young judo athletes following the intervention. This further supports the idea that systematically implemented and well-structured motor programs can positively influence the development of manipulative motor skills in school-aged children. Likewise, in a study by Lee et al. (2020), an eight-week intervention with structured activities conducted three times per week led to significant improvements in both TGMD-2 domains (*locomotor and manipulative skills*), along with an overall increase in physical activity levels.

CONCLUSION

The results of this study demonstrated that the implementation of a short, structured instructional program within judo training can lead to an improvement in manipulative skills among school-aged children. Based on these findings, it is recommended that activities aimed at developing manipulative skills be incorporated into judo training for children, as they contribute to overall child development while being relatively simple to apply.

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USING AN INERTIAL MEASUREMENT UNIT (IMU) TO ASSESS UCHI-KOMI EXECUTION SPEED PROFILE

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ABSTRACT

This study explores the use of an inertial measurement unit (*IMU*) to analyse the speed at which Uchi-Komi is performed. Three amateur judokas performed Seoi Nage entries continuously for 60 seconds while a smartphone-based IMU recorded triaxial accelerometer and gyroscope signals. These data were then filtered and analysed using the Hilbert transform to estimate the athletes' instantaneous execution speed. The results showed that the yaw-axis gyroscope signal provided the most consistent representation of the drill's periodicity, enabling the reliable extraction of speed profiles. Distinct temporal patterns were observed among the athletes, reflecting fluctuations in rhythm, fatigue and technique. While one judoka maintained a stable speed throughout, the others exhibited progressive declines after 30–40 seconds, which is consistent with the effects of fatigue. These findings demonstrate the feasibility of using IMUs to monitor Uchi-Komi performance and highlight their potential as a wearable tool for coaches and athletes. Future work will focus on validating this approach against gold-standard methods and extending it to a broader range of judo techniques.

Keywords: *IMU, Uchi-Komi, Wearable,*

INTRODUCTION

In recent years, wearable technology has become increasingly prevalent in sports science, offering new ways to monitor, quantify and improve athletic performance. Among these technologies, inertial measurement units (*IMUs*) have gained particular relevance thanks to their portability, affordability and ability to capture motion data outside laboratory environments. Typically combining accelerometers, gyroscopes, and sometimes magnetometers, IMUs allow for the accurate measurement of variables such as acceleration, angular velocity, orientation, and derived kinematic parameters (Dehzangi & Sahu, 2018) (Hellmers et al., 2018) (Gujarathi & Bhole, 2019). Their application in sports has expanded rapidly and is now used in activities ranging from running (Portuese et al., 2020), skiing (Presicci et al., 2025), team sports (Lima et al., 2023) and combat disciplines (Manoharan et al., 2023). IMUs have particularly been used to evaluate movement quality, identify fatigue (Zhou et al., 2024), prevent injuries (Rasmussen et al., 2023), and offer coaches and athletes with objective feedback during training (Kim et al., 2017). Unlike traditional motion capture systems, which require complex and expensive setups, IMUs enable performance evaluation in real training conditions, thereby increasing ecological validity.

Uchi-Komi is considered one of the most fundamental training methods in judo. By repeatedly performing the initial phase of techniques, athletes can improve their timing, coordination, balance (*Kuzushi*) and body positioning. This exercise is widely used at all levels of practice, from beginners to elite judokas, as it enables the systematic improvement of technical execution in a controlled environment. As well as improving technique, Uchi-Komi also helps to condition judokas physically. High-volume repetitions enhance muscular endurance, speed of movement and neuromuscular coordination, while the dynamic, repetitive nature of the drill simulates the demands of competition. Coaches use Uchi-Komi to improve technical accuracy, develop rhythm and reaction time, and hone the ability to execute techniques efficiently under fatigue.

Due to its central role in judo training, the Uchi-Komi assessment provides valuable insights into an athlete's technical proficiency and physical readiness. Athletes are typically evaluated based on the number of repetitions performed at maximum speed within a defined time period. However, the way in which this maximum speed changes over time is not evaluated, even though this could be useful for analysing physical condition and/or helping the judoka maintain a consistent speed during the Uchi-Komi exercise.

In this paper, the signal provided by the IMU during a Uchi-Komi execution are recorded and analyzed in order to obtain the Uchi-Komi execution profile. The remainder of this paper is organised as follows. Section 2 describes the materials and methods employed in this study. Section 3 presents the main results a detailed discussion. Finally, Section 4 summarizes the conclusions and outlines potential directions for future research

MATERIALS AND METHODS

This study involved a group of three amateur judokas who participated voluntarily. All participants had a minimum of three years' training experience. The objectives and procedures of the study were explained prior to participation, and informed consent was obtained.

A smartphone equipped with the Sensor Logger app was placed on the judoka's torso to record the inertial measurement unit. The smartphone was secured with an elastic strap to minimise motion artefacts. The IMU included a triaxial accelerometer and gyroscope, sampled at 500 Hz, with the angles defined as shown in Fig. 1a During each trial, the athletes were instructed to perform continuous Uchi-Komi Seoi Nage entries at their maximum sustainable speed for 60 seconds (see Fig. 1b), while maintaining correct technique. The raw data were stored and processed using a MATLAB script.



a) Definition of angles

b) Uchi Komi sequence

Fig. 1. The photograph shows the experiment.

First, the raw accelerometer and gyroscope signals recorded during the Uchi-Komi sequence were filtered using a fourth-order Butterworth low-pass filter with a cut-off frequency of 5 Hz, to reduce high-frequency noise unrelated to body motion.

The Hilbert transform $H\{x(t)\}$ was then used to assess the Uchi-Komi speed due to the periodicity observed in the raw data.

$$H\{x(t)\} = \frac{1}{\pi} \text{p.v.} \int_{-\infty}^{\infty} \frac{x(\tau)}{(t-\tau)} d\tau \quad \text{eq. (1)}$$

where p.v. denotes the Cauchy principal value of the integral. The Hilbert transform generates a complex-valued analytic signal $\tilde{x}(t)$ from a real signal $x(t)$, as shown in eq (2):

$$\tilde{x}(t) = x(t) + jH\{x(t)\} = A(t)e^{j\phi(t)} \quad \text{eq. (2)}$$

Where $A(t)$ was the instantaneous amplitude and $\phi(t)$ denoted the instantaneous phase. The main outcome variable was the execution speed of Uchi-Komi ($\#UK/s$), which was defined by the instantaneous frequency $f(t)$ according to eq. (3) which was calculated using a small windows time of 0.5 s to improve the robustness and interpretability of the execution speed estimation.

$$f(t) = \frac{1}{2\pi} \frac{d\phi(t)}{dt} \quad \text{eq(3)}$$

RESULTS AND DISCUSSION

Fig. 2 shows the temporal evolution of the acceleration and gyroscope data measured by the IMU unit during a 60-second Uchi-Komi test sequence for the Seoi Nage technique. As can be seen, the measured data reflect the periodicity of the activity performed. For the Seoi Nage technique, this periodicity is more evident in the Y-axis gyroscope data. This signal was therefore used to estimate the execution speed using the procedure explained in the previous section.

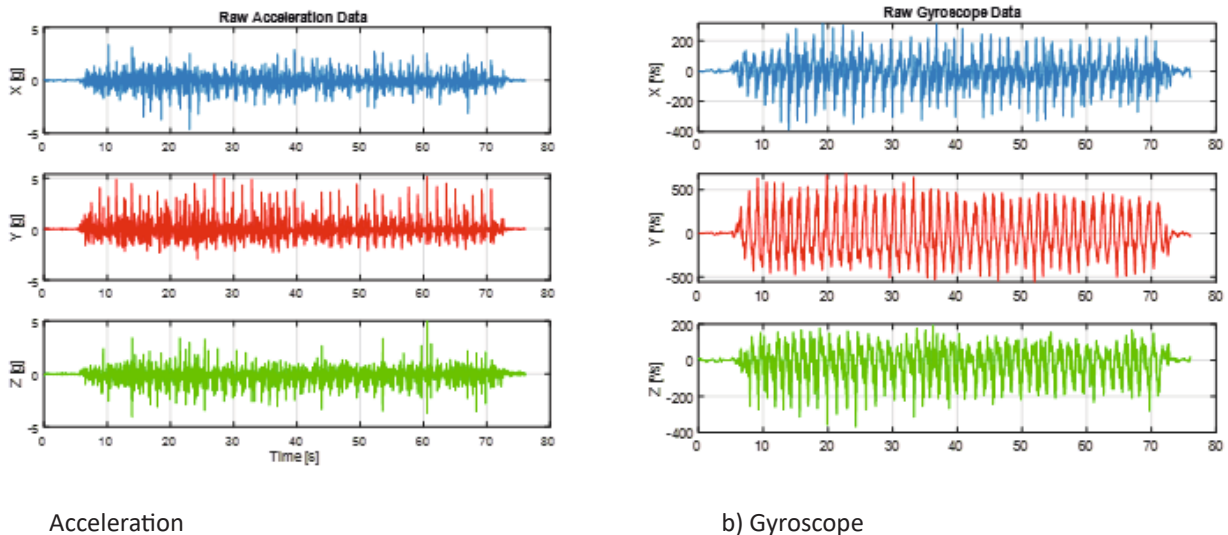


Fig. 2. Raw data measured by the IMU during the Uchi Komi sequence.

The execution speeds of the Uchi-Komi of three different judokas were calculated and plotted in Fig. 3. Judoka A's execution speed fluctuates around 0.8–0.9 repetitions per second, with transient peaks exceeding 1.0 and occasional decreases towards 0.6, as can be seen. This variability reflects natural fluctuations in rhythm and effort during the drill. However, the overall trend shows that the athlete can maintain a relatively stable execution speed over the 60-second interval. Judoka B's execution speed exhibits oscillatory fluctuations, ranging from 0.9 to 1.2, during the first 30 seconds. After 30 seconds, a sustained downward trend becomes evident, characterised by a progressive reduction in both the mean value and the oscillation amplitude. It should be noted that this judoka did not complete the full sequence, stopping after 55 seconds. Finally, judoka C exhibited relatively stable oscillatory behaviour during the first 40 seconds, with values ranging from approximately 0.9 to 1.2. Beyond 50 seconds, a sustained downward trend became evident, characterised by a progressive decrease in the mean level together with reduced-amplitude, irregular oscillations. Transient fluctuations were observed around 40 seconds, but these did not alter the overall downward trend. This transient fluctuation was attributed to incorrect technique.

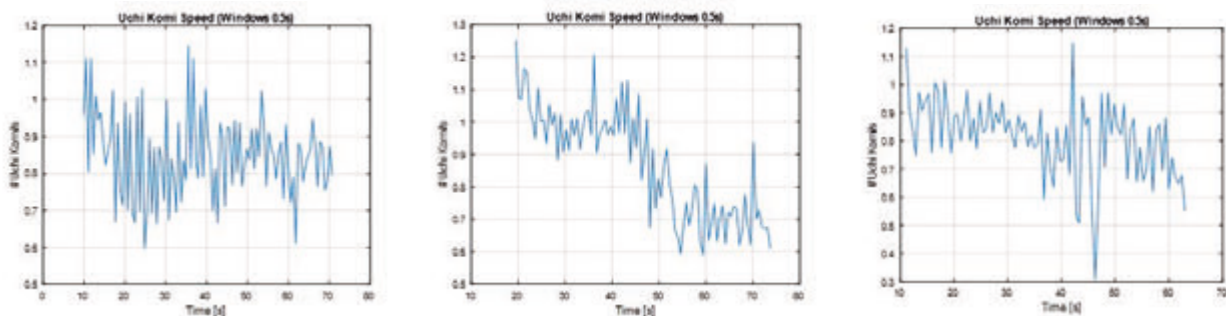


Fig. 3. Uchi-Komi execution speed profile.

CONCLUSIONS

The gyroscope recordings along the yaw axis clearly demonstrated the rotational dynamics of the judo technique. The analytic signal obtained via the Hilbert transform made it possible to extract the Uchi-Komi execution speed profile. This paper evaluates the Uchi-Komi speed of three amateur judokas over a 60-second period to validate the functionality. However, there are some issues that remain to be addressed in future research. These include thoroughly validating the measurements obtained against the gold standard method and extending the algorithm to measure execution speed for any Tachi-Waza technique. Nevertheless, these preliminary results pave the way for the development of a new wearable system that could transform the way in which judokas are evaluated. Trainers could use this profile as an alternative quantitative method of assessing their athletes' physical condition. Furthermore, providing this data in real time would allow training protocols to be defined based on Uchi-Komi execution speed.

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PRACTICAL APPLICATION OF ISCHEMIC PRECONDITIONING INTERVENTION ON JUDO ATHLETES: EFFECTS ON EXERCISE PERFORMANCE AND RECOVERY

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ABSTRACT

This study examines the effects of Ischemic Preconditioning (IPC) on judo performance and recovery. While findings on performance are mixed, with some studies showing improvements in tests like the Special Judo Fitness Test and others showing no benefit, the effects on recovery are more consistent. IPC application aids post-exercise recovery by lowering heart rate and blood lactate, improving jump performance, and reducing muscle soreness. A practical application protocol of 3x5-minute occlusion at 220 mmHg on the limbs is outlined. Although its impact on performance is inconclusive, IPC is a promising tool for enhancing recovery in judo athletes, warranting further standardized research.

Keywords: recovery, combat sports, performance, blood flow restriction, exercise

INTRODUCTION

Ischemic preconditioning (IPC) is recognized as a widely used non-invasive physiological intervention aimed at enhancing athletic performance and improving the efficiency of recovery (de Groot et al., 2010; Salvador et al., 2016; Carvalho et al., 2019; Ceylan & Franchini, 2022; Ceylan et al., 2023). The IPC technique typically involves repeated cycles of brief vascular occlusion and reperfusion, which are thought to induce protective and adaptive responses in muscle tissue, potentially improving tolerance to subsequent exercise stress.

Despite its increasing use in sports science, the effects of IPC on judo performance remain inconclusive and continue to be debated (Ribeiro et al., 2019; Ceylan & Franchini, 2022; Ceylan et al., 2023). The existing literature on the influence of IPC on judo athletes' performance and recovery is relatively limited. While certain studies have demonstrated improvements in performance parameters following IPC application (Ribeiro et al., 2019), others have reported no significant enhancement in performance, yet observed notable improvements in recovery efficiency (Ceylan & Franchini, 2022; Ceylan et al., 2023).

Accordingly, the purpose of the present study was to explain the mechanism of IPC intervention, to examine its effects on judo performance and recovery, and to demonstrate the application procedure to participants within a practical framework.

Ischemic preconditioning intervention and mechanism

Ischemic Preconditioning (IPC) is known as a non-invasive method involving repeated cycles of brief blood flow restriction followed by reperfusion. The IPC intervention was first employed by Murry et al. (1986) to assess its cardioprotective effects in animal models. Their findings indicated that a 40-minute IPC protocol (4 sets of 5 minutes) had a protective effect against prolonged and severe ischemia in cardiac tissue. Specifically, they reported enhanced myocardial protection during the reperfusion phase and increased resistance of cardiac cells to extensive ischemic injury. In recent years, IPC has become widely used in the field of sports science, particularly as a strategy to enhance athletic performance and improve post-exercise recovery efficiency (de Groot et al., 2010; Salvador et al., 2016; Carvalho et al., 2019; Ceylan & Franchini, 2022; Ceylan et al., 2023).

Although IPC is commonly utilized as an ergogenic aid to optimize performance and recovery, its underlying physiological mechanisms remain not fully understood. However, it is hypothesized that IPC elicits both acute and chronic physiological

responses that may play a supportive role in enhancing or improving athletic performance. From a physiological perspective, the effects of IPC are often explained through mechanisms such as increased mobility of red blood cells, enhanced oxygen delivery capacity, improved blood flow due to vasodilation, more efficient oxygen transport to tissues, and accelerated energy production through increased mitochondrial efficiency. In terms of recovery, improvements are often attributed to reduced oxidative stress, protection of cellular structures, and mechanisms that safeguard tissue from damage (Marocolo et al., 2025).

Currently, there is no standardized IPC protocol established in the literature. Protocols vary significantly in terms of cuff pressure, application site, and duration. However, the most commonly used protocols include 3 sets × 5 minutes and 4 sets × 5 minutes of occlusion and reperfusion. In terms of cuff pressure, levels above systolic blood pressure—typically ranging between 180–200 mmHg—are frequently preferred (O'Brien & Jacobs, 2021). Regarding the application site, IPC is usually administered via inflatable cuffs placed on the proximal portion of the limb that is predominantly used during exercise. The reperfusion phase begins once the inflated cuffs are completely deflated. The occlusion and reperfusion phases are performed in an alternating and synchronized manner (de Groot et al., 2010; Ceylan & Franchini, 2022; Ceylan et al., 2023). However, O'Brien and Jacobs (2021), in their review, argued that the diversity in IPC protocols may compromise the reliability and comparability of findings in the literature. They emphasized the need for the development and implementation of standardized protocols to ensure consistency in research outcomes.

The effect of ischemic preconditioning on judo performance

The effects of IPC on athletic performance remain a topic of ongoing debate. However, studies demonstrating a positive impact on performance appear to outnumber those reporting no significant effect (Incognito et al., 2016). When examining the influence of IPC on judo performance, the literature appears relatively limited. While some studies report improvements in judo performance following IPC intervention (Ribeiro et al., 2019), others have found no significant effect (Ceylan et al., 2023). For instance, Ribeiro et al. (2019) reported that judokas in the IPC group achieved lower Special Judo Fitness Test (SJFT) index scores (12.11 ± 1.09) compared to those in the SHAM (placebo IPC) group (12.65 ± 1.90), suggesting that IPC is a practical, cost-effective, and efficient strategy to enhance judo performance. Moreover, they noted that hemodynamic responses (e.g., heart rate, blood pressure) were similar between the IPC and SHAM groups. Based on this, the authors argued that the IPC group performed a higher workload with equivalent physiological effort. Supporting these findings, another study demonstrated that judokas achieved a greater total number of throws under similar physiological loads following IPC intervention, as indicated by lower SJFT index scores, thereby highlighting IPC's potential to enhance short-term maximal judo performance (Ribeiro et al., 2018). Similarly, Ceylan and Franchini (2022), in their investigation into the effects of IPC on judo performance, observed no differences in SJFT outcomes between the IPC and control groups, ultimately concluding that IPC did not improve judo performance.

The effect of ischemic preconditioning on the recovery process

IPC may enhance recovery efficiency by delaying fatigue during the post-exercise recovery period (Barbosa et al., 2015), and by positively affecting variables such as heart rate (HR), perceived muscle stiffness, and countermovement jump (CMJ) performance (Ceylan et al., 2023). However, studies investigating the effects of IPC on post-exercise recovery in judokas are still limited in number.

In a study examining the acute effects of IPC on recovery, it was found that IPC significantly reduced heart rate at both the 30th and 60th minutes of the recovery period. Additionally, CMJ performance was superior in the IPC group compared to the placebo group, and perceived muscle soreness was reported to be lower following IPC intervention. These findings suggest that IPC may serve as a practical tool to enhance the recovery efficiency of judokas (Ceylan et al., 2023). Similarly, in a separate study by Ceylan and Franchini (2022), IPC was found to result in lower HR and blood lactate (bLA) values compared to the control condition. Based on these results, the authors suggested that IPC may help reduce physiological stress and enhance recovery efficiency following intense exercise.

Application of ischemic preconditioning (airbands)

In the practical session, ischemic preconditioning (IPC) will be applied to the proximal regions of both thighs. Before initiating the procedure, participants will receive a verbal explanation of the entire protocol. The intervention will be performed using an AirBands IPC device, with a pressure setting of 220 mmHg, a value commonly used in the literature (Ceylan et al., 2023).

Since judo is a sport in which both the upper and lower extremities are predominantly utilized (*Franchini et al., 2011*), the IPC intervention will be applied to both the upper and lower limbs as part of the practical protocol. The IPC intervention can be conducted using AIBANDS devices.

For the upper extremities, participants will be seated, and the cuffs will be symmetrically placed on the proximal portion of both arms. In the upper extremity, the application protocol is generally similar to that used for the lower extremity—typically consisting of three sets of five minutes of compression followed by reperfusion. However, the level of compression applied may differ. A review of the literature indicates that compression pressures in the upper extremity vary widely, ranging from 50 mmHg to 220 mmHg (*Lisboa et al., 2017; Mota et al., 2020; Bellini et al., 2023; Teixeira et al., 2023*). For the lower extremities, participants will be in a supine position, and the cuffs will be symmetrically applied to the proximal portion of both thighs. The intervention will be carried out at a commonly used pressure level of 220 mmHg, consisting of 3 sets of 5-minute occlusion followed by 5-minute reperfusion intervals for each limb segment (*O'Brien & Jacobs, 2021; Ceylan & Franchini, 2022; Ceylan et al., 2023*), resulting in a total application time of 30 minutes.

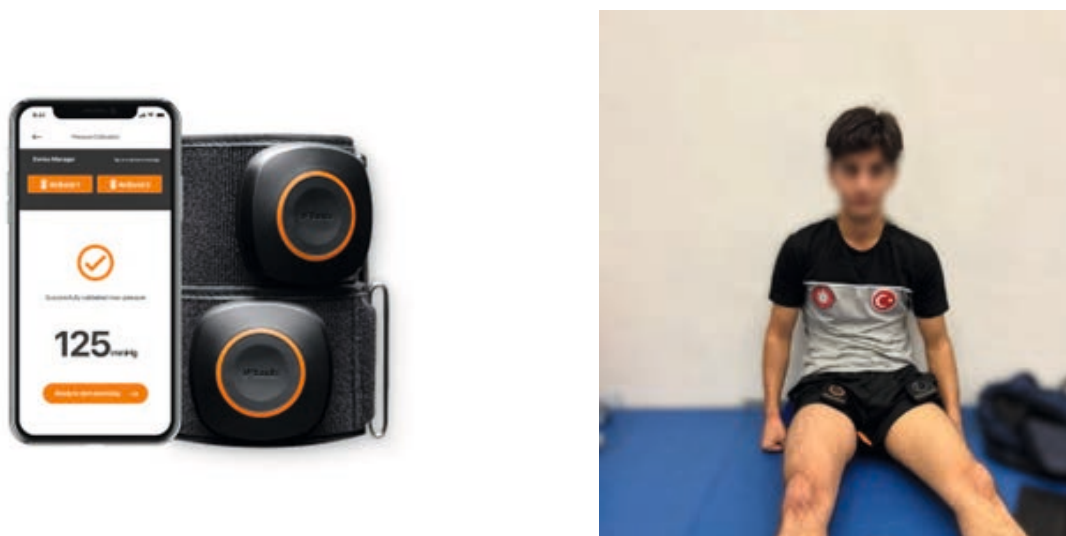


Figure 1. The ischemic preconditioning device and cuffs to be used in the application and IPC intervention for judo athlete

CONCLUSION

In conclusion, the effect of IPC intervention on judo performance and recovery remains inconclusive. However, a review of the literature reveals that several studies have reported positive outcomes. Therefore, it is considered important for sports scientists, coaches, and athletic performance specialists working in judo to be familiar with IPC applications, as this knowledge may help optimize athletes' performance and recovery processes. It is also anticipated that practical implementation sessions of IPC may help fill the existing gap in the literature and provide guidance for future scientific studies.

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CO-CREATING CALM: CULTIVATING EMOTIONAL AWARENESS, LEARNING, AND MASTERY THROUGH JUDO

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ABSTRACT

This paper invites judo coaches, athletes, and sport psychologists to join an international network dedicated to developing and adapting the CALM model—Cultivating Emotional Awareness, Learning, and Mastery—a framework designed to promote emotional regulation and psychological skills through judo. Originally developed as an intervention to reduce anger and violence, CALM has evolved into a flexible model applicable across competitive and developmental contexts. The model emphasises co-construction, encouraging athletes and coaches to actively shape the design and delivery of psychological strategies. This initiative proposes that each participating country or club creates their own culturally adapted version of CALM, supported by shared principles and ongoing knowledge exchange. By embedding psychological support within judo training and tailoring it to local needs, the CALM network aims to enhance athlete well-being, performance, and emotional mastery. This presentation marks the start of a global effort to unite practice and psychology through a shared yet locally owned approach.

Keywords: *Judo, emotional regulation, coaching psychology, co-construction, international collaboration*

INTRODUCTION

Combat sports offer a powerful platform to promote emotional development, self-regulation, and life skills—yet too often, psychological interventions are either overly generic or disconnected from the practical realities of coaching. The CALM model—Cultivating emotional Awareness, Learning, and Mastery was developed to bridge this gap. Rooted in applied sport psychology and grounded in the lived experience of judo and combat sport practitioners, CALM provides a flexible framework for helping athletes recognise, understand, and manage their emotional responses, particularly anger, stress, and frustration. It is not a one-size-fits-all programme; instead, CALM encourages athlete and coach ownership in shaping how psychological skills are introduced and embedded. The purpose of this paper is to invite practitioners to collaborate internationally in adapting and extending the CALM model within their own countries and coaching contexts.

The calm model—cultivating awareness, learning, and mastery

The original CALM programme, as detailed in Lane (2025), used a sport-led, psychologically-informed approach to guide participants in managing emotional challenges through structured sessions involving discussion, goal setting, movement-based practices, and mental skills training. A key feature of CALM is that it does not treat psychological skills as abstract add-ons. Instead, emotional awareness and regulation are integrated into the sporting experience itself by using the rhythms, relationships, and routines of judo to make psychological learning relevant and lasting. The success of the model depends not only on its psychological soundness, but also on its co-constructed delivery: athletes and coaches play an active role in shaping how sessions are run, what examples are used, and how skills are applied to their specific environment.

Global calm – the next steps

This collaborative principle lies at the heart of the next phase of development. Rather than seeking to rigidly export CALM as a fixed intervention, this presentation makes a call to build an international network of judo practitioners and psychologists, each working to co-create a version of CALM that fits their culture, language, values, and goals. Whether working with grassroots youth, competitive juniors, or elite adult athletes, the principles of CALM via building awareness, fostering self-regulation, and developing mastery can be adapted and enriched by local expertise. The proposal here is not to simply spread CALM, but to invite co-leaders in its evolution: country-specific versions that draw on shared psychological foundations while allowing for maximum contextual relevance.

Judo provides an ideal setting for this approach. It is both physical and philosophical, demanding not only technique but self-discipline, respect, and mental resilience. These qualities align perfectly with CALM's psychological goals. However, the way these values are taught and experienced varies greatly across countries and cultures. In some settings, athletes face extreme weight-cutting pressures; in others, socio-emotional development may be a key aim of participation. In some clubs, coaches may already incorporate reflective practice; in others, psychological concepts may be unfamiliar. This diversity is not a problem to be solved—it is a resource to be harnessed. By forming an international CALM network, each participating country or club can create tailored versions of the model, guided by shared values but shaped by local need.

The scientific and coaching communities in judo are well placed to drive this process. Research such as Morales-Sánchez et al. (2024) shows that psychological interventions are more successful when integrated into training routines and adapted to athletes' contexts. Meanwhile, studies like Gómez-Carmona et al. (2022) and Franchini et al. (2013) highlight the emotional and physiological strain judo places on competitors, reinforcing the need for robust mental preparation. CALM offers a framework to address these challenges—but its true potential will only be realised when coaches and athletes themselves become co-authors of its development. Tanabe et al. (2025) showed how a co-constructed approach provided useful data on coach-athlete perceptions.

Co-construction

This presentation does not offer a finished programme. Instead, it offers a starting point and a structure for action. The CALM model provides a conceptual framework, a set of guiding principles, and a flexible toolkit. What is now needed is a group of collaborators; coaches, players, psychologists, and researchers who are willing to trial, adapt, reflect, and contribute. A simple shared commitment can unify this network: to support athletes in developing emotional mastery through judo. From this shared commitment, each country or region can contribute case studies, training examples, challenges, and innovations. Over time, these contributions will form a collective knowledge base, grounded in practice and enriched by diversity.

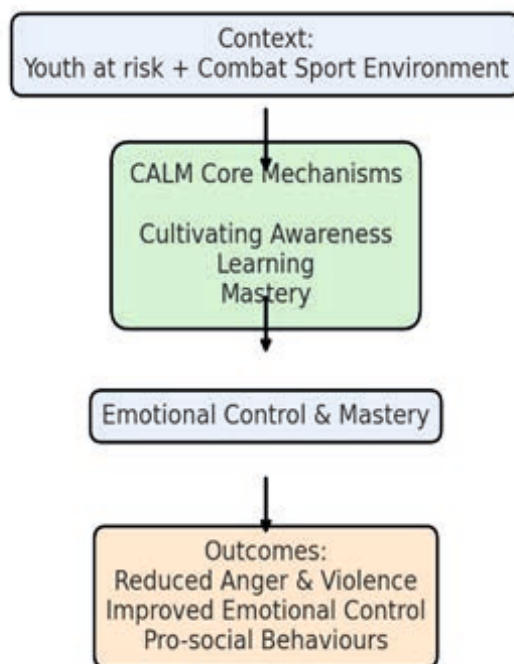


Figure 1 The CALM process

CONCLUSION

In sum, this work calls for the formation of an international, practitioner-led CALM network: a collaborative space where judo coaches and sport psychologists co-design interventions that are psychologically sound, practically embedded, and culturally meaningful. CALM provides a shared framework, but its future must be co-constructed; locally owned, globally connected, and always evolving. Coaches are not simply implementers of someone else's psychology but are critical agents of change. This project invites them to lead, shape, and innovate together.

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KINESIOFOBIA AND SELF-PERCEPTION OF RETURN TO PLAY IN ELITE JUDOKAS AFTER AN INJURY: A CROSS-SECTIONAL STUDY.

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ABSTRACT

Introduction: Judo is an Olympic contact sport with a high risk of injury due to its physical, technical, and competitive demands. The role of psychological factors in recovery and return to sport has been scarcely explored in Spanish-speaking populations. Kinesiophobia and self-perception toward return to play (RTP) are key elements in the injury process, influencing both the success and timing of return, and are affected by variables such as locus of control, previous experience, and contextual factors.

Objective: To investigate the relationship between sociodemographic, clinical-sport, and psychological variables with kinesiophobia and self-perception of RTP, to identify psychological profiles.

Methods: A cross-sectional observational study was conducted at the High-Performance Judo Center (C.E.A.R.) in Valencia, Spain; involving 52 elite Spanish-speaking judokas who were injured, out of competition, or in the process of returning to training or competition. Data were collected through a self-administered questionnaire. Psychological variables were assessed using the Tampa Scale for Kinesiophobia (TSK-11) and the “Cuestionario sobre la Autopercepción del Deportista para la Reincorporación al Entrenamiento”. Descriptive, comparative (*Welch's t-test*, *ANOVA*, and *Pearson correlations*), and cluster analyses (*K-means*) were performed.

Results: No significant associations were found between sociodemographic, clinical, and psychological variables. Cluster analysis identified three differentiated psychological profiles.

Conclusions: Three psychological profiles were identified: young judokas with low self-perception and minimal kinesiophobia; older judokas with high self-perception and low fear; and a more vulnerable group with longer recovery times, high kinesiophobia, and low self-perception. Further studies with more specific and biopsychosocial approaches are needed.

Keywords: Judo, injury, self-perception, kinesiophobia, return to play.

INTRODUCTION

Judo is a martial art and Olympic combat sport that integrates both standing and groundwork fighting. Its practice demands multiple physical capacities such as maximal strength and strength endurance, power, flexibility, and both aerobic and anaerobic conditioning (Chaabene et al., 2017; Karatrantou et al., 2020; Torres-Luque et al., 2016), as well as complex technical and tactical skills (Branco et al., 2013; Franchini et al., 2018). Due to the nature of its movements, direct contact, and competitive intensity, judo carries a significant risk of injury, with incidence rates comparable to or even higher than those reported in team sports (Kim et al., 2015; Kujala et al., 1995). Although evidence varies depending on diagnostic criteria and study settings, a high prevalence of knee and shoulder injuries has been observed, with variations according to sex, age, and weight category (Poccecco et al., 2013; Souza et al., 2006). Recent rule changes and preventive strategies indicate a downward trend in severe injuries, although the overall risk remains considerable at the elite level (Frey et al., 2019).

Judo injuries affect not only athletes' physical well-being but also have a significant psychological and social impact. The Return to Play (RTP) process is complex, involving multiple physical, psychological, and contextual factors, making it a difficult and highly relevant decision. Athletes who are not psychologically ready to return show greater avoidance and hypervigilant behaviours, while those who return before being mentally prepared experience higher anxiety, fear, and

reduced performance (Juggath & Naidoo, 2024). Several authors highlight that adequate psychological readiness and self-confidence are essential, as factors such as motivation, confidence, and absence of fear are associated with a faster and more successful return (Ardern et al., 2013).

Kinesiophobia, which is prevalent after injury, typically manifests initially as fear of movement and later, closer to RTP, as fear of re-injury. This fear-avoidance pattern creates a vicious cycle: fear leads to avoidance, avoidance leads to disuse and muscle inhibition, which in turn reinforces the perception of incapacity, affecting both physical function and self-confidence (Meeuwisse et al., 2007).

Several psychological factors influence self-perception and kinesiophobia. An internal locus of control is associated with greater self-regulation and responsibility during recovery, whereas an external locus is linked to vulnerability and unpredictability (Murphy et al., 1999). Identification with other injured athletes may either promote preventive behaviours or increase fear and avoidance, depending on how it is perceived (Bandura, 1986; Deroche et al., 2012). Classical conditioning explains how a movement associated with pain can trigger an automatic fear response, even when no structural damage remains. Operant conditioning further reinforces this pattern, as avoiding painful movements temporarily reduces anxiety, thereby consolidating the fear-avoidance response (Miguez et al., 2014; Rescorla & Wagner, 1972).

Personality traits such as neuroticism, trait anxiety, and perfectionism tend to favour avoidant coping styles and poorer adaptation, while active coping and cognitive restructuring are associated with better RTP outcomes (Ormel et al., 2013). Some authors even suggest that genetic differences may modulate psychological traits relevant to injury recovery (Anastasiou et al., 2024).

Among contextual factors, competitive pressure, the need for rapid decision-making under stress, and the individual nature of performance outcomes increase psychological demands (Anastasiou et al., 2024; Rouveix et al., 2007). Rapid Weight Loss (RWL), highly prevalent among judokas, is often carried out using extreme and poorly controlled methods, with physical consequences such as dehydration, syncope, and performance deterioration, as well as psychological effects including tension, fatigue, irritability, sleep disturbances, and disordered eating behaviours. Female athletes specifically show higher indicators of eating disorder risk and body image dissatisfaction (Štangar et al., 2022). Moreover, in interdependent training environments, an injury within the group can alter team dynamics, reduce motivation, and shift the locus of control externally (Juggath & Naidoo, 2024).

Despite the growing recognition of psychological factors in the injury process, evidence in elite judo remains limited. A deeper understanding of the relationship between kinesiophobia and psychological readiness for RTP would enable the design of more effective and safer interventions, optimizing both recovery and performance.

The objective of this study was to analyse the relationship between sociodemographic, clinical, and psychological variables with kinesiophobia and self-perception of return to sport in injured elite judokas. Secondary objectives included describing the incidence and characteristics of musculoskeletal injuries, examining determinants of kinesiophobia and RTP self-perception according to these variables, and identifying psychological profiles associated with readiness for return to play.

METHODS

An observational, cross-sectional, and descriptive study was conducted under the research department of the Universidad Católica de Valencia San Vicente Mártir (UCV). The study was approved by the UCV research ethics Committee (protocol UCV/2022-2023/082) and conducted in accordance with the Declaration of Helsinki. All participants were informed of the study objectives and provided written informed consent prior to participation.

Data collection took place in person at the Centro de Alto Rendimiento de Judo de Valencia (C.E.A.R.) during April 2025 through a self-administered, voluntary questionnaire completed in a single session.

The sample consisted of 52 elite judokas (male and female), all active competitors over 16 years of age, Spanish-speaking, and experienced in national and international competitions. All participants had sustained a relevant musculoskeletal injury and were either out of competition or in the process of returning to training or competition.

Sociodemographic variables (age, sex), clinical variables (weight category, injury characteristics and location, time since injury onset, and time out of competition), and psychological variables (kinesiophobia and psychological readiness to

return to play) were collected using the Spanish version of the Tampa Scale for Kinesiophobia (TSK-11) and the Athlete's Self-Perception Questionnaire for Return to Training.

Statistical analysis was performed using JAMOVI software (v.2.6.26.0). Descriptive statistics (frequencies, means, and standard deviations) and comparative tests (Student's *t*-test and one-way ANOVA), as well as Pearson correlations, were applied. Additionally, a K-means cluster analysis with standardized (*Z*-score) variables was conducted to identify distinct psychological and clinical profiles. Only complete questionnaires were included, and no sensitivity analyses were performed.

RESULTS

The sample included 52 elite judokas aged 16 to 31 years, of whom 51.9% were women and 48.1% men; there were no dropouts or incomplete questionnaires.

Table 1: Sample characteristics.

	N	%	Mean	SD	Mode	Min	Max
MALE	25	48,1%	22.9	0.799	24.0	17	31
FEMALE	27	51,9%	23.0	0.718	23.0	16	31

The most prevalent injury sites were the knee (40.4%), followed by the shoulder (28.8%), and hand, elbow, and ankle-foot regions (9.6%). By injury type, ligament injuries (42.3%) and muscle injuries (26.9%) were the most frequent.

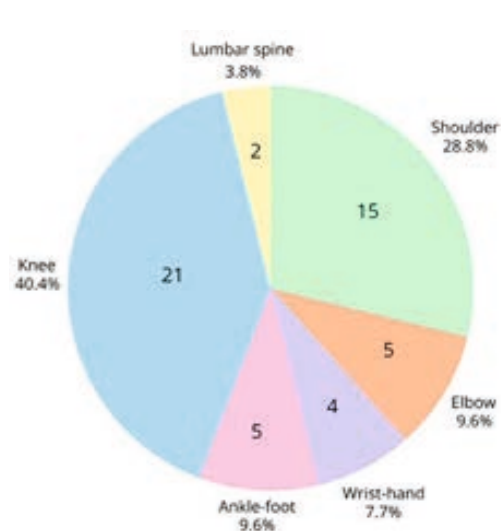


Figure 1: Distribution of injuries by location.

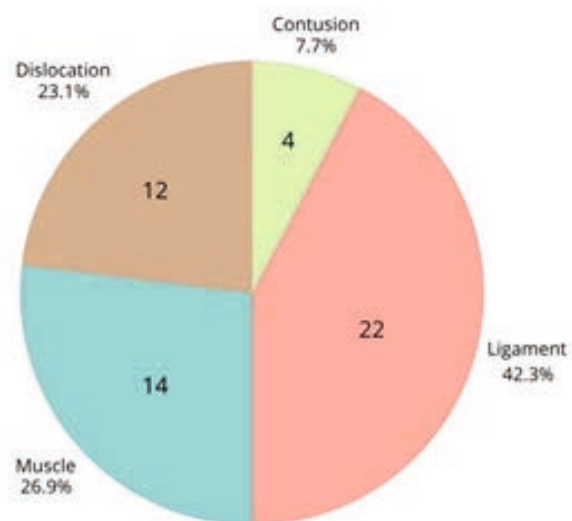


Figure 2: Distribution of injuries by type.

Regarding psychological variables, the mean TSK-11 score was 25.02 ± 5.73 , with higher values in the fear-avoidance dimension (15.58 ± 4.14) than in harm (9.44 ± 2.48). The "Cuestionario sobre la Autopercepción del Deportista para la Reincorporación al Entrenamiento" showed a mean of 36.5 ± 5.24 . According to its clinical cutoffs, 19.2% of judokas demonstrated adequate readiness, 46.2% intermediate readiness requiring further evaluation, and 34.6% inadequate readiness.

Table 2: Outcome data.

	Mean	SD	Min	Max	N	Frequency
TSK_TOTAL	25.02	5.73	11	37		
TSK_AVOIDING	15.58	4.14	7	25		
TSK_HARM	9.44	2.48	4	15		
RTP_TOTAL	36.50	5.24	24	48		
READY					10	19.23%
FURTHER_AS- SESSMENT					24	46.15%
NOT_READY					18	34.61%

No statistically significant differences were found in kinesiophobia or self-perception scores according to sex, weight category, injury type or location, or time out of competition ($p > 0.05$).

Table 3: Comparison of psychological variables according to sociodemographic and clinical factors (p-values).

		TSK_TOTAL	TSK_AVOIDING	TSK_HARM	RTP_TOTAL
Sex (Welch's t-test)		0.719	0.812	0.662	0.731
Age (Pearson's r)		0.369	0.195	0.938	0.429
Weigh category (One-way ANOVA F-test)	Male:	0.945	0.952	0.727	0.937
	Female:	0.704	0.903	0.601	0.134
Type injury (One-way ANOVA F-test)		0.675	0.888	0.347	0.074
Location injury (One-way ANOVA F-test)		0.704	0.707	0.660	0.662
Time since injunry onset (Pearson's r)		0.084	0.146	0.121	0.526
Time out competition (Pearson's r)		0.177	0.186	0.363	0.371

The K-means cluster analysis identified three distinct psychological profiles: younger judokas with low self-perception and minor kinesiophobia; older judokas with high self-perception and low fear; and a more vulnerable group with prolonged injuries, high kinesiophobia, and low self-perception.

Table 4: K-means Clusters analysis results

	N	TSK_TOTAL	RTP_TOTAL	TIME_SINCE_IN- JURY	TIME_OUT	AGE
Cluster 1	16	1.120	-0.155	0.623	0.513	-0.083
Cluster 2	18	-0.158	-0.212	-0.489	-0.366	-0.828
Cluster 3	18	-0.837	0.350	-0.065	-0.090	0.902

DISCUSSION

Although existent literature suggests greater psychological vulnerability among female judokas (*increased risk of eating disorders and adverse effects of rapid weight loss, RWL*), our findings did not support this trend. This suggests that unmeasured moderators (*such as coping style, trait or state anxiety, locus of control, personality traits, acceptance, or catastrophizing*) may play a more decisive role than sex itself. No differences were found across weight categories;

however, the unequal representation of these categories likely limited statistical power, potentially masking expected RWL related effects (Mohammadi, 2019; Quan et al., 2025; Randall E. Osborne & Seth A. Doty, 2022).

The distribution of injury locations aligned with previous literature, whereas differences in injury types may be attributed to the specific characteristics of the sample. The absence of associations between injury-related and psychological variables may reflect individual variability in pain perception and coping, as well as the lack of detailed analysis regarding injury severity.

Neither time since injury nor time out of competition correlated with psychological variables, suggesting that the passage of time alone does not ensure psychological adjustment. Instead, recovery appears to depend on process related factors such as therapeutic support, injury severity or stage, and acceptance (Baranoff et al., 2015).

The mean TSK-11 score (25.0 ± 5.7) indicated a moderate level of fear-avoidance, while the mean self-perception score (36.5 ± 5.2) reflected intermediate readiness. Only 19.2% of athletes were deemed psychologically ready, while 80.8% lacked sufficient readiness for return to play. Although no significant correlation was found between total TSK and self-perception, athletes with higher readiness tended to show lower fear-avoidance and total TSK scores, suggesting a potential clinical relationship.

The cluster analysis revealed three distinct psychological profiles. Findings suggest that age and psychological maturity modulate the interaction between kinesiophobia and self-perception: younger athletes tend to exhibit low confidence despite low kinesiophobia, whereas older athletes display less fear and greater security, likely due to a stronger internal locus of control and more developed coping strategies from experience. Conversely, a group characterized by high fear, low self-perception, and longer recovery times reflected a psychologically vulnerable profile consistent with the fear-avoidance model, emphasizing the need for individualized psychological assessment and tailored interventions to promote a safer and more effective return to sport.

Main limitations include the uneven sample distribution across some weight categories, the lack of injury severity data, and the omission of key variables such as years of experience, injury history, and psychological factors (*coping, anxiety, locus of control, and personality traits*). Future research should incorporate these dimensions and employ longitudinal designs to track recovery processes, validate psychological profiles, and optimize interventions for a safer and more effective return to play.

CONCLUSIONS

Musculoskeletal injuries in elite judokas most commonly affect the shoulder and knee, with no sex differences or clear associations with weight categories. No significant relationships were observed between sociodemographic or clinical-sport variables and psychological outcomes, underscoring the need for studies focused on athletic maturity, experience, and injury specificity. Cluster analysis revealed three psychological profiles: younger judokas with low readiness but minimal fear; older athletes with greater confidence and lower kinesiophobia; and a vulnerable group with high fear, low self-perception, and longer injury durations. Overall, the judokas displayed an intermediate psychological profile, with non-disabling kinesiophobia but insufficient readiness in most cases. These findings highlight the importance of integrating psychological assessment and intervention into injury management and considering contextual and biopsychosocial factors to ensure a safe and effective return to sport.

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PERSONALITY TRAITS AND ATTITUDES TOWARD JUDO: AN EXPLORATORY STUDY AMONG FIRST-YEAR STUDENTS

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INTRODUCTION

Judo (*the Gentle Way*) is one of the most widespread combat sport in the world and is recognized not only as a competitive sport but also as a powerful pedagogical tool at universities worldwide, contributing to the development of personality, social skills, and values among young people. The founder of judo, Jigoro Kano, emphasized the principles of Seiryoku zenyo (*maximum efficiency with minimum effort*) and Jita kyoei (*mutual welfare and benefit*), which continue to represent the fundamental educational dimensions of this sport today (Kano, 1986). As both a pedagogical and moral system, judo provides an excellent framework for exploring the relationship between personality traits and attitudes toward sport, learning, and personal development (Sterkowicz-Przybycień, Blecharz, & Sterkowicz, 2017; Kisieliene & Arlauskaitė, 2007). The course Theory and Methodology of Judo (5 ECTS) is taught to first-year students at the Faculty of Sport and Physical Education, University of Sarajevo, as a means of developing discipline, perseverance, self-confidence, and respect for others. Personality traits refer to stable individual characteristics that explain consistent patterns of feeling, thinking, and behaving (Pervin, Cervone, & John, 2005), whereas an attitude represents a learned tendency to respond positively or negatively to an object, person, or situation based on experience (Ajzen, 2005). Selected personality traits such as openness to new experiences, conscientiousness, extraversion, agreeableness, and emotional stability may shape students' perception, motivation, and engagement in sports activities. Previous studies (Leuzzi et al., 2024) suggest that individuals who practice martial arts tend to show higher levels of openness, conscientiousness, extraversion, and agreeableness, as well as lower levels of neuroticism and psychological distress. Moreover, existing research shows that conscientiousness and emotional stability contribute to calm and fair behavior in sports, while extraversion and agreeableness facilitate cooperation and communication (Costa & McCrae, 2012; Piepiora & Witkowski, 2020; Lampe et al., 2024). Conversely, elevated neuroticism may negatively affect concentration and stress management in demanding situations (Schlatter et al., 2022).

Studies of students' and pupils' attitudes toward combat sport generally report positive perceptions, although gender and individual differences are evident (Biletić et al., 2008; Busch et al., 1999). Given its pedagogical and moral dimensions, judo represents a suitable platform for examining the relationship between personality and attitudes, since characteristics such as self-confidence, perceived competence, and self-regulation can enhance active participation in instruction and foster long-term motivation for learning and teaching younger generations. Despite numerous studies addressing personality and sports preferences, research specifically focused on judo and first-year university students remains scarce. Considering that this period marks a transition and the formation of new educational attitudes, investigating the relationship between personality traits and attitudes toward judo may contribute to a better understanding of the educational potential of this sport and help optimize both instructional and training programs. The aim of this study is to examine the relationship between the personality traits of first-year students and their attitudes toward judo.

METHODS

Sample of Participants

The study included first-year students of the Faculty of Sport and Physical Education at the University of Sarajevo in the 2024/2025 academic year who attended and completed the course Theory and Methodology of Judo ($n = 45$), with an average age ($M = 19.3$ years, $SD = 6.2$). The number of male students was significantly higher ($n = 32$; 71.1%) than the number of female students ($n = 13$; 28.9%). Due to this gender imbalance, participants were treated as a single, unified

sample in the main analysis. A convenience sample was used, consisting of all first-year students who attended and completed the course during the study period. Instruments

The predictor set of variables was assessed using the BFI-10 personality questionnaire (*Rammstedt & John, 2007*), consisting of 10 items, each composed of two short phrases based on trait adjectives corresponding to the prototypical model. The measured traits were Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to Experience.

The criterion set of variables was measured using the Judo Attitude Scale (*SBS1*) (*Bosnar, Sertić, & Prot, 1996*), designed to assess attitudes toward judo. The scale included 22 items covering aspects of perception, safety, discipline, and values associated with judo. The scale included the following items: SBS1. I would never practice judo; SBS2. I do not understand people who enjoy fighting; SBS3. Judo is exclusively beneficial for physical development; SBS4. Judo encourages aggressiveness; SBS5. I enjoy overcoming an opponent using my intelligence and skill; SBS6. Judo is not a more dangerous activity than other combat sport; SBS7. Judo should be banned because it encourages violence among people; SBS8. Judo promotes the development of many mental functions; SBS9. I enjoy watching judo applied in real conditions; SBS10. Judo should be included in the mandatory physical education curriculum; SBS11. Judo teaches self-control and respect for others; SBS12. I would not allow my child to practice judo; SBS13. Judo encourages setting new personal goals; SBS14. Judo requires discipline and dedication; SBS15. Skills learned in judo are valuable in everyday life; SBS16. Judo makes us more tolerant; SBS17. Judo does not appeal to me because there is always a risk of injury to myself or others; SBS18. Training in judo increases stress resilience; SBS19. Combativeness is a noble human trait; SBS20. Judo is extremely violent and therefore undesirable; SBS21. Judo should be more promoted in education through media; SBS22. Judo needs greater popularization.

Procedure

At the end of the first winter semester of the 2024/2025 academic year, students' personality traits and attitudes toward judo were measured. Participants were informed that the survey was anonymous and voluntary and that they could withdraw at any time. The survey was conducted exclusively for research purposes. Students rated the statements on a 5-point Likert scale, where 1 = strongly disagree and 5 = strongly agree.

Reliability

To determine the reliability of the Judo Attitude Scale (*SBS*), Cronbach's alpha was calculated. Cronbach's alpha coefficients for the personality traits were Extraversion (.353), Agreeableness (.625), Conscientiousness (.444), Neuroticism (.610), and Openness (.471). For attitudes toward judo, the scale demonstrated excellent reliability and internal consistency among students ($\alpha = .894$).

Statistical analysis

The normality of variable distributions was assessed using the Kolmogorov–Smirnov test, which indicated that the variables were not normally distributed. Descriptive parameters (*minimum, maximum, mean, and standard deviation*) were calculated. Because the variables were not normally distributed, Spearman's rho correlation analysis was used to calculate the relationships between personality traits and attitudes toward judo, using SPSS 22.0 at a significance level of 0.05.

RESULTS

Descriptive analysis revealed a balanced and stable psychological profile among students, characterized by higher levels of extraversion ($M = 3.85$; $SD = 1.17$), conscientiousness ($M = 3.64$; $SD = 1.13$), and moderate openness to experience ($M = 3.59$; $SD = 1.28$). Lower neuroticism scores ($M = 2.94$; $SD = 1.26$) indicate emotional stability, while agreeableness ($M = 3.16$; $SD = 1.26$) showed moderate values. Attitudes toward judo indicated a generally positive perception of this sport among students. The highest mean values were recorded for items related to self-control, respect, and discipline. The lowest mean values were observed for statements expressing concern about safety or injury risk. Spearman's correlation analysis showed that most relationships did not reach statistical significance, suggesting weak associations between personality dimensions and specific attitudes toward this martial art. However, several significant correlations indicate potential patterns worth noting. A positive correlation was found between Agreeableness and the perception that

judo fosters physical development ($r = .348, p < .05$). Conscientiousness showed significant positive relationships with tolerance ($r = .325, p < .05$) and caution about injury ($r = .353, p < .05$). Neuroticism was negatively correlated with the statement that judo requires discipline and dedication ($r = -.308, p < .05$). Openness demonstrated a negative association with the idea that judo is beneficial only for physical development ($r = -.311, p < .05$).

Table 1. Descriptive statistics of personality traits and attitudes toward judo.

	N	Min.	Max.	Mean	Std. Dev.
Extraversion	43	1.00	5.00	3.84	1.17
Agreeableness	43	1.00	5.00	3.16	1.26
Conscientiousness	43	1.00	5.00	3.63	1.12
Neuroticism	43	1.00	5.00	2.94	1.25
Openness	43	1.00	5.00	3.59	1.27
SBS1	43	1.00	5.00	3.25	1.46
SBS2	43	1.00	5.00	3.95	1.47
SBS3	43	1.00	5.00	3.16	1.60
SBS4	43	1.00	5.00	4.53	.98
SBS5	43	1.00	5.00	4.58	.76
SBS6	43	1.00	5.00	1.93	1.22
SBS7	43	1.00	5.00	4.58	1.09
SBS8	43	1.00	5.00	4.48	.76
SBS9	43	1.00	5.00	3.13	1.35
SBS10	43	1.00	5.00	3.44	1.14
SBS11	43	1.00	5.00	4.46	.82
SBS12	43	1.00	5.00	4.39	1.09
SBS13	43	1.00	5.00	4.16	.89
SBS14	43	1.00	5.00	4.27	.95
SBS15	43	1.00	5.00	3.93	1.03
SBS16	43	1.00	5.00	4.00	1.02
SBS17	43	1.00	5.00	4.00	1.21
SBS18	43	1.00	5.00	3.79	1.10
SBS19	43	1.00	5.00	4.18	1.09
SBS20	43	1.00	5.00	4.39	.97
SBS21	43	1.00	5.00	3.79	1.10
SBS22	43	1.00	5.00	4.02	1.18

Table 2. Spearman's rho correlations between personality traits and attitudes toward judo.

	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness
SBS1	-.151	.161	.115	-.101	.001
SBS2	.044	.003	.235	-.088	-.056
SBS3	.066	.348*	.059	-.046	-.311*
SBS4	-.003	-.070	.094	-.068	.112
SBS5	-.038	.070	-.041	-.174	.109

SBS6	.110	.112	.133	-.001	.010
SBS7	.292	-.254	-.252	.200	.022
SBS8	-.036	-.158	.064	-.177	.251
SBS9	-.269	.135	.230	-.138	.010
SBS10	.037	.076	.139	-.100	-.152
SBS11	-.004	-.109	.094	-.007	-.004
SBS12	.039	.137	.296	-.277	.164
SBS13	-.032	-.002	.173	-.265	.146
SBS14	-.048	-.241	.164	-.308*	.241
SBS15	-.017	-.152	.240	-.213	.158
SBS16	.018	.003	.325*	-.284	.150
SBS17	.106	.021	.353*	-.289	.230
SBS18	-.049	.131	.235	-.182	.101
SBS19	-.170	-.049	.211	-.055	.053
SBS20	-.083	-.006	.182	.092	.137
SBS21	-.009	-.169	.209	-.118	.174
SBS22	-.199	-.071	.205	-.175	.243

*Correlation is significant at the 0.05 level

DISCUSSION

The aim of this study was to explore the relationship between personality traits and students' attitudes toward judo, and the obtained results indicate that the defined objective was fully achieved. The findings suggest that first-year students enrolled in the course Theory and Methodology of Judo possess a balanced psychological profile, characterized by higher levels of extraversion, conscientiousness, and openness to experience. These results are consistent with previous research emphasizing that participation in combat sport may be associated with greater emotional stability, self-control, and social orientation (Piepiora & Witkowski, 2020; Leuzzi et al., 2024). However, the identified correlations between personality traits and attitudes toward judo were limited and generally weak, suggesting that personality may have only a partial influence on perceptions about judo.

The positive association between agreeableness and the perception that judo fosters physical development indicates that empathetic and cooperative individuals tend to perceive the sport as harmonious rather than aggressive. Conversely, the relationship between conscientiousness and attitudes concerning tolerance and injury risk reflects a disciplined yet cautious approach to physical competition (Costa & McCrae, 1992; Piepiora, 2021). The negative correlation between neuroticism and the belief that judo requires discipline and dedication suggests that emotional instability may reduce the ability to recognize its educational values (da Gama et al., 2018). The absence of stronger correlations can likely be explained by the homogeneity of the sample and the fact that most participants had no prior experience with judo. Therefore, attitudes toward judo are probably more influenced by the educational context, motivation, and pedagogical approach than by stable personality traits.

The obtained results confirm the value of judo as an educational system which, in accordance with Jigoro Kano's principles of mutual welfare and benefit (*Jita kyoei*) and maximum efficient use of energy (*Seiryoku zenyo*), can contribute to the development of discipline, tolerance, and social responsibility. Limitations and Future Research: The study is limited by the relatively small and homogeneous sample and by the use of the short BFI-10 questionnaire, which may not capture all nuances of personality. The research was based on a convenience sample of students from a single institution, which limits the generalizability of the findings. Future research should include larger and more diverse samples, longitudinal designs, and comparisons between students with and without prior judo experience.

CONCLUSION

The obtained results indicate that students' personality traits may have a limited yet notable influence on their perception of judo. Although personality can shape the way students experience this martial art, prior experience, personal motivation, and the educational context in which judo is studied appear to play a more decisive role in shaping attitudes. This research provides valuable guidelines for designing educational programs that use judo as a pedagogical tool for developing self-control, discipline, and social values.

The findings also highlight the need to integrate psychological and moral aspects into university curricula, thereby positioning judo as an instrument of students' personal and professional development. Future research should further explore the relationship between personality traits and academic achievement, which would contribute to a deeper understanding of the role of judo in students' educational and personal growth.

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EMOTION REGULATION TRAINING FOR JUDO COACHES: PROPOSAL FOR THE 10-WEEK TRAINING PROGRAM BASED ON THIRD WAVE CBT INTERVENTIONS

Rebeka Prosoli

ABSTRACT

Psychological preparation is integral (*and often neglected*) part of sport preparation. Mental health represents a huge concern in recent years with experts presenting alarming numbers. Coaches and athletes are part of that alarming statistics. Emotion regulation is often mentioned as important for both athletes and coaches. However, they are often left on their own in trying to figure out how exactly to do that. In this paper, the short 10-week emotion regulation training for judo coaches is presented and explained. It is argued that sport psychologists and mental health experts should be integral part of the sport teams, and that this kind of interventions could represent one small part of the equation.

Keywords: *coach education, mental training, psychological preparation*

INTRODUCTION

The idea that psychological preparation is important is not new. We witness every day elite athletes, as well as their coaches, talking about how psychological skills are necessary for achieving top results. Also, psychological preparation represents one of the four types of sport preparation, alongside physical, technical and tactical ones. However, the reality is that other forms of preparation get several hours a day, almost every day of the week, while athletes (*as well as their coaches*) dedicate little to no time to psychological preparation. Psychological skills can be trained just like any other skills. They as well require time, effort and training, not just „hoping“ and „wishing“ for confidence, concentration and optimal emotional regulation during the sport events. There is no optimal amount of talking about speed that would result in faster athlete. Same is with psychological skills.

One could wonder what would happen if the same approach is given to other three forms of preparation? What would happen if coaches would train the other forms of preparation using just talking about it occasionally, giving the athletes full responsibility for it, and maybe implementing some exercises they collected along the way? Also, one could dream about what would happen if the psychological preparation would be given the same treatment as other forms of preparation. If the psychological preparation would be carefully implemented in training programs, assessed, planed, tracked, executed and evaluated with the same „nothing is left to chance“ mindset. Maybe it is time to help coaches in training the psychological skills with the same serious dedication which is given to the other parts, starting with their formal education and following with sport psychologist being integral part of coaching staff. In sport, especially in elite sport, every move and every second counts. Experts in sport psychology (*see Weinberg & Gould, 2019*) still don't quite understand how treating one of the four main forms of preparation differently than others (*and sometimes almost completely neglecting it*) makes sense.

The problem becomes even deeper if we add the mental health component to the equation. The mental health is growing concern in the recent years with both researchers and practitioners emphasize the need to start acting not today, but yesterday. Even before COVID-19 pandemic research suggested that almost 30% of high school students in Croatia report serious symptoms of anxiety and stress while 20% of young people report serious symptoms of depression (*Novak et al., 2018*). In the same research, around 15% of participants reported that they thought about committing suicide, almost 9% already made the plan, and around 4% reported attempting suicide already. Another research (*Jokić Begić et al., 2020*) reported that 1 in 5 young boys and 1 in 3 young girls reported mental health difficulties. In the same research, 30% of students reported mild to moderate symptoms of depression while 34% participants reported severe symptoms of depression. Similar numbers were reported for anxiety.

Athletes are not immune or resistant to mental health problems. Findings from the studies conducted on college athletes reported up to 21% prevalence rate of depression (Wolanin et al., 2015). Also, research suggests that athletes experience similar rates of anxiety disorders as general population (Reardon et al., 2021). Furthermore, just training judo represents the risk factor for developing eating disorders which prevalence (*alongside of disordered eating*) is up to 19% in male and 45% in female athletes (Bratland-Sanda & Sundgot-Borgen, 2013).

Research also shows that eating disorders are more prevalent among elite young athletes in comparison to lower-level athletes, recreative athletes and general population (Marrows et al., 2023). Recent study conducted in 2024 on 24 combat sport competition reported that most of the athletes showed indication of disordered eating even up to 28 days after competition (Doherty et al., 2024). For the half of the participants in this study the numbers were so concerning that authors advised seeking the support from the experts.

Since sport coaches play an important role in shaping athletes sport experiences they are recognized as people in unique position to make major contribution to the mental health of their athletes (Donovan et al., 2006). The question is: do they get enough knowledge and support to be able to do that? On the other hand, we should be concerned for their own mental health as well, since research shows that 39% of the elite level coaches (Netherlands and Belgium) showed symptoms of depression/anxiety and 19% of them showed symptoms of distress as well as adverse use of alcohol (Kegelaers et al., 2021). Maybe it is time to think about equipping them with better resources.

Since emotions are recognized as important part of sport outcomes, which can influence the practice of sport coaching in the same way, one can argue that the effective regulation of emotional reactions has implications not only on performance but well-being as well (Davis & Davis, 2016). Therefore, the 10-week training program for judo coaches was developed with the aim to educate and train coaches in emotion regulation techniques which they can then use on themselves as well as while working with the athletes.

The framework used for the training program, as well as the interventions, is based on similar transdiagnostic training programs described in existing literature (ART; Berking & Whitley, 2014; EFT; McKay & West, 2016) as well as well-established literature in psychotherapy (Gross & Ford, 2024; Leahy et al., 2011). The program is based on CBT (Cognitive behavioural therapy), ACT (Acceptance and Commitment Therapy), CFT (Compassion Focused Therapy) and Mindfulness theoretical and practical frameworks. Also, since the program is aimed for the sport coaches, some techniques from sport psychology are explained and implemented into the lessons as well. It is important to note that training programs based on mindfulness and aimed at sport coaches already exists and are described in sport literature (Longshore & Sachs, 2015; Lebeau et al., 2024; Tian & Cheng, 2025).

This shows relevance of such evidence-based interventions in coach settings. The idea of here described 10-week program is that similar mindfulness-based program could be next step in this journey to support coaches and their well-being. However, at this time, the broader approach may be better fit for Croatian coaches since the sport psychology is not broadly used nor available in Croatia. After this initial introduction to emotions and emotion regulation, coaches can be introduced to more specific programs (e.g. 8-week mindfulness program) aimed to further improve their well-being as well as coach-athlete relationship.

OVERVIEW OF THE TRAINING PROGRAM

Aims of the program

The aims of this program are to strengthen the capacity to deal with stress, better understanding of oneself and one's reactions, and more conscious decision-making about one's behavior in the role of coach.

Program outline

First week coaches are introduced to the program. In that week, the first lesson is about profile of good sport coach as well as values. Values are important because they give direction to our behavior and the way we want to live our lives. At the end of this week coaches make their own profile as well as analyze which values they want to represent as a coach, and how. Second week coaches are learning about emotions and are introduced to concepts of understanding, recognizing, and naming the emotions, identification of their function as well as managing emotional reactions. The neuroscience behind emotions and practical benefits of each intervention is described. The awareness intervention

is implemented with several practical tasks to complete (*e.g. daily emotion log, detecting emotions in body, recalling emotional experiences, emotional mental notes*). Third week is dedicated to breathing and relaxation exercises where the neuroscience behind those interventions is explained, and coaches are given several exercises to practice during the rest of the program. Fourth week is dedicated to awareness, acceptance and compassion exercises where the emphasis is put on demonstrating the importance of emotions, nonjudgemental awareness, defusion exercises, self-compassion, and planning of pleasant activities. On the fifth week coaches are introduced to CBT model where connection between emotions, thoughts, physical sensations and behavior is explained.

The practical emphasis is put on importance of directing thoughts to present moment and task at hand during sport events. Coaches are directed to track their thoughts and connect them to other parts of CBT model to demonstrate interdependence of all the aspects included. Sixth and seventh weeks are dedicated to techniques aimed at working with thoughts in different ways (*e.g. analyzing, finding alternative thoughts, recognizing cognitive distortions and bring all the steps together*). Eighth week is dedicated to power poses and use of body posture in sport context.

Ninth week coaches learn about arousal and are trained in recognizing optimal, too low and too high arousal as well as implementing various techniques in managing their arousal levels. And finally, the last week is dedicated to learning about things they can and cannot control in sport environment, and they are presented with COPE model (*Anshel, 1991*) which is suggested as quick and structured way to manage cognitive and behavioral demands during stressful combat sport events.

How the program will be delivered

The training program consists of 10 weekly themes. It will be conducted on-line with pre-recorded videos (*duration up to 60 minutes*). Every lesson comes with practical demonstrations and practical exercises which are later part of practical homework. During the 10-week period participants will get one lesson and materials at the beginning of each week and all the materials will be available for 6 months. Therefore, participation in the program is self-paced but coaches are encouraged to complete no more than one lesson a week so they can have enough time to practice the techniques and implement the knowledge.

Participants

In the preliminary study 40 judo coaches from Croatia will participate in the 10-week on-line program. The participation is voluntary, and the program is free for all participants.

Teacher

Teacher for the program has PhD in psychology, is licensed sport psychologist in Croatia, currently is under supervision as CBT therapist and mindfulness teacher and have formal education in ACT and CFT. The teacher will be available through e-mail during the whole duration of the program and coaches will be offered individual feedback.

Questionnaires

In order to evaluate the program, the participants will be asked to fill several questionnaires before and after completing all the lessons: (1) Depression, Anxiety and Stress Scale (*DASS-21*) (*Lovibond & Lovibond, 1995*), (2) The distress tolerance scale (*Simons & Gaher, 2005*), (3) Difficulties in emotion regulation scale (*Gratz & Roemer, 2004*), (4) Emotion regulation skills questionnaire (*ERSQ*) (*Berking et al. (2008)*). After the program, the coaches will be able to provide their feedback in open ended questions where they will be asked about what they think was helpful, what they think needs to improve and what suggestions for improvement they may have.

Limitations

The effectiveness of this program is yet to be evaluated through pilot implementation. Possible limitations of the pilot implementation are small number of participants from only one sport, time constraints for the coaches since the program is long and requires a practical implementation, and no way of knowing if (*and how*) the coaches will complete and implement the exercises.

CONCLUSION AND FUTURE DIRECTIONS

Psychological preparation is integral part of sport preparation, and it is crucial that coaches and federations start to treat it in that manner. Emotion regulation training for coaches is not and cannot be the only answer but it is a good start in order to start introducing these topics to coaches and athletes.

In the future, it is crucial to implement topics about sport psychology and mental health to yearly coaching seminars but also to make sport psychologists and mental health experts (*clinical psychologists, psychotherapists*) integral part of sport teams, coaching staff and federation bodies. It is time to take psychological preparation and well-being of athletes and coaches very seriously since they enter until (*and after*) they leave sport. Talking about it and education is a great start but it is not enough since psychological skills (*as any other skills*) must be trained and implemented in order to see a change. Short training programs as this one could be part of the answer, alongside other interventions.

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NEGATIVE PHENOMENA IN JUDO AMONG YOUTH ATHLETES IN THE CZECH REPUBLIC

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ABSTRACT

The review article discusses possible negative phenomena in sports, especially in judo. Currently, we can observe a number of negative phenomena in society, but also in sports, which can have a very negative impact on the health, psychological and social development of young judokas. It is important not only to draw attention to these phenomena, but also to address them preventively and pay attention to them in the judo training process.

INTRODUCTION

The authors draw attention to the possible risks of young judokas, where, in addition to the positive effects of judo processes, negative manifestations may also occur. If judo coaches do not intervene with a corrective effect, these negative manifestations may manifest themselves significantly and weaken the character and moral qualities of young judokas. It is therefore desirable to be aware of these possible phenomena and, above all, to prevent them.

Topic issues

Sport, or rather judo, is a social phenomenon that affects individuals and the entire society. It has health, social, economic, promotional, and international effects. Sports activities can have a positive effect on individuals, but on the other hand, sports life and the sports environment of judo also bring many risks.

Judo is a very popular Olympic sport that attracts many young people and in the Czech Republic, this was and is strongly reinforced by the triumphs of the two-time Olympic champion in judo, Lukáš Krpálek.

Judo has its own philosophy and etiquette; it teaches young judoka respect, humility and courtesy. It develops the fitness, technical, tactical, psychological and aesthetic aspects of young judoka, including the development of their personality and character.

On the other hand, in recent years we have also encountered negative behavior in some young judoka, which in turn disrupts the training process and performance of young judoka and impairs their personality and character. It is therefore necessary in the training process of young judoka to focus preventively on the negative phenomena in judo listed below and thus prevent the further development and reinforcement of this inappropriate behavior.

Not only in the sports field but also in other social areas, we can observe a shift in society towards a more passive and consumerist way of life, where there is room for various undesirable and negative manifestations in human life. What is striking is that the age at which these problems appear is increasingly shifting into earlier developmental periods (*childhood and youth*).

In the environment of judo and sports in general, there are factors that have a positive effect on physical and mental health, on psychological resilience, especially outside the comfort zone, and thus bring feelings of happiness, joy and satisfaction.

In addition to positive manifestations, the environment of judo and sports (*including children and youth categories*) also brings negative phenomena. In this case, adult authorities (*parents, teachers, coaches, educators, etc.*) play a significant role. Their efforts should aim to divert young athletes from various inappropriate temptations often present.

Another important role (*positive and negative*) is played by peers who can divert judoka from negative phenomena or, on the contrary, encourage negative manifestations in behavior.

Negative phenomena in sport and in judo itself include a number of factors that can be divided into many areas and that concern judoka themselves as well as their loved ones, coaches, sports organizations, and fans in the wider society.

On the part of judoka, this can be, for example, an attempt to cheat, dishonest and unethical behavior, an effort to win at all costs, unfair actions, intrigues, feigning injuries and simulation, intentional violation of rules, etc. (Nekola, 2019).

Another negative phenomenon is the use of prohibited substances (*doping*), by which a judoka artificially increases their performance. Other negative phenomena in judo can also include tendencies towards substance and non-substance addictions, behavioral disorders, increased impulsivity and uncontrollable aggression.

We can also include overloading the body, health problems from excessive training, emotional burnout, amotivation (Jansa et al., 2012).

Judoka can also come under increased psychological pressure and as a result, they can experience anxiety and neurotic states, depressive experiences, self-harm, eating disorders, especially in girls, etc. In the Czech Republic, within consultations and psychotherapy, we have dealt with several cases of eating disorders among young female judoka who competed in kata.

Another negative phenomenon, even in younger judoka, can be attempts to influence referees and violations of fair play rules.

In this context, we are talking about the so-called general negative impacts on the psychological development of young judoka, which can include, for example, the loss of a sense of fair play, i.e., winning at all costs, intrigues, slander even in the media or on social networks, and the unhealthy influence on youth - a certain tolerance of drugs, alcohol, cigarettes, nicotine pouches, gummy bears with THC, etc. (Nekola, 2019).

Negative phenomena show that judo and the sport itself are not only about health and joy, but also about the risks associated with money, pressure and injustice. Therefore, it is important to remind everyone of the values of fair play, respect and a healthy lifestyle.

In children and young people, negative phenomena in judo manifest themselves a little differently than in adults. It is often not about doping or big money, but rather about pressure, an unhealthy environment, inappropriate habits and poor leadership by coaches and parents themselves (Perič, 2018).

This is primarily due to unnecessary overexertion, which is exerted on the one hand by coaches and on the other hand by the parents themselves. Sometimes children "burn out" already at the age of 15-16.

Psychological pressure and stress, as already mentioned, are often from the parents themselves, their expectations ("you have to win, otherwise you have disappointed us"), and are also contributed to by the fear of failure, competition among peers, which increases anxiety and neurotic symptoms and lowers self-confidence and self-esteem in children and young people, which can sometimes even lead to the cessation of sports activities.

Another factor in this area is the coaches themselves. Some, despite having professional qualifications, fail on the so-called human side. They humiliate their charges, shout at them, negative evaluations prevail, talented individuals are preferred to the detriment of others, who subsequently gradually lose motivation for sports activities.

A significant factor in this area are also inappropriate role models and inappropriate behavior from other judoka. A coach who smokes, abuses alcohol, or violates fair play rules is certainly not a suitable role model for the young generation of judoka.

Increased and recurring injuries related to judo training and competition can also negatively affect whether a young judoka will continue in their sports career or not. If it is not a question of so-called severe health impacts on the health of young judoka, increased concerns about health in children can also be reinforced by the parents themselves.

Among the negative phenomena in children and youth who play judo, inappropriate interactions and behavior between children can also be considered, especially if it is not corrected in time by parents and coaches.

For young people, the main threat is excessive pressure - from parents, coaches and the environment. Judo should mainly be fun, developmental and healthy for children, not stress and the pursuit of results.

Therefore, the prevention of negative phenomena in judo in children and youth is of great importance rather than dealing with the consequences later.

Judo plays a very important role in the lives of children and youth. It brings them joy, healthy exercise, the opportunity to make friends, and teaches them cooperation and fair play.

The Role of the Coach

The coach is a significant authority for the child and often a role model. Therefore, it is important that they have not only professional sports knowledge but also pedagogical and psychological skills. The right coach motivates positively, praises not only results, but also effort and teamwork. He gives children an appropriate load and ensures the safety of training. He should set an example with his behavior - act decently, fairly and with respect for opponents and referees (Perič, 2018).

The Role of the Parents

Parents should support the child but not overdo it with pressure to perform. Judo should be a joy for the child, not a duty. It is important to have realistic expectations - not everyone will be a professional judoka, an Olympic champion, but everyone can improve their health and gain good experiences thanks to sport (Vičar, 2018).

Parents should maintain a balance between judo, school and rest and cooperate with coaches instead of putting additional pressure on them.

Organization of Sports Activities

Versatility is essential in childhood. Children should try more sports to properly develop their coordination, agility and fitness. One-sided specialization should come later. Training must be playful, fun and appropriate. Competitions should be scheduled appropriately so that the child does not suffer from stress and overload. Adequate recovery and sleep are essential components of judo.

Health Prevention

Health prevention includes regular medical check-ups and monitoring the child's development. Healthy habits also play a big role - proper nutrition, hydration and sleep. It is also important to learn the correct movement technique, practice grips, falls and use appropriate sports equipment to prevent injuries (Štěřbová et al., 2022). In judo, great emphasis is placed on weight (*mass*), and it is also necessary to monitor the risk of eating disorders.

Well-being

The judo sports environment must be safe for the child, without fear of mistakes or failures. Children need self-confidence, support, praise and the opportunity to talk openly about problems. If psychological difficulties arise, a sports psychologist can also help (Tod et al., 2017).

Social Environment

Social environment and the atmosphere in the club also play a big role. Although judo is an individual sport, it should teach children cooperation, not rivalry at all costs (Gonzalez et al., 2018). Coaches and parents should prevent bullying and promote respect for others. Even those who are not the best should be included in the club team so that everyone feels that they belong somewhere.

Awareness Raising and Education

Prevention also includes education in fair play, explaining the risks of doping and emphasizing the right life values. Awareness should be focused not only on children, but also on parents and coaches, for example through training or discussions.

Financial Accessibility

Last but not least, it is important that sport is available to all children, not just those from wealthier families. Schools, sports clubs and cities should create conditions so that children whose parents cannot afford expensive equipment or training can exercise.

CONCLUSION

Preventing negative phenomena in judo among children and young people is based on striking a balance between performance and the joy of movement. If coaches, parents, and schools create a supportive and healthy environment, judo will not only improve children's physical fitness, but also give them mental resilience, friendships, and values that they will carry with them throughout their lives.

The IJF and EJU have many programs focused on children and youth (*including programs for children with disabilities*), and the prevention of negative phenomena in judo is at the center of their attention, as it is in the Czech Judo Association.

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THE 4 DOJOS: A MOTOR STORY WORKSHOP TO FOSTER POSITIVE ATTITUDES TOWARDS INCLUSION IN JUDO

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ABSTRACT

Inclusive education is a cornerstone of human rights. In sport, teachers' attitudes strongly influence whether participants with intellectual developmental disorders (IDD) are successfully included. This paper introduces The 4 Dojos workshop, a motor story-based activity designed to raise awareness, foster empathy, and strengthen judo teachers' capacity to use multiple means of communication. Grounded in the Universal Design for Learning (UDL) framework, the workshop uses four communication modes—voice, movement, symbols, and cooperation—to mirror the diverse ways athletes may understand and engage with practice. By temporarily restricting communication channels, participants (*judo teachers*) are placed in situations where they may feel disoriented or frustrated, simulating the barriers learners with IDD often face. A pilot conducted in March 2025 with international judo teachers highlighted the workshop's effectiveness in stimulating cooperation, empathy, and reflection. Future evaluation will use the J-TAID (*Judo Teachers' Attitudes towards Inclusion of Individuals with IDD*) survey to assess its measurable impact, guided by the Theory of Planned Behavior. The 4 Dojos contributes a practical, evidence-informed tool to foster positive attitudes and inclusive practices in judo education.

INTRODUCTION

Inclusive education, emphasized by UNESCO (2023), is central to ensuring equal participation and the social development of all individuals. Within this context, judo offers unique benefits for individuals with neurodevelopmental disorders, including physical, social, emotional, and cognitive growth (Descamps et al., 2024). The success of such initiatives, however, depends largely on teachers' beliefs and attitudes (Descamps et al., 2024b). Teachers with positive attitudes toward inclusion are more likely to adapt instruction, apply cooperative strategies, and ensure meaningful participation (Avramidis & Norwich, 2002; de Boer et al., 2011). To address potential negative attitudes, experiential awareness programs are increasingly recommended (Reina et al., 2021; Grimminger-Seidensticker & Seyda, 2022). Among these, motor stories—activities that merge narrative, movement, and reflection—have proven especially effective in raising empathy, mobilizing emotions, and challenging stereotypes (Martos-García & Pans, 2021; Monforte et al., 2021; Sáez-Gallego et al., 2024). Building on this approach, The 4 Dojos was developed as an adaptation of the motor story “The Diverse Galaxy” (Sáez-Gallego et al., 2023, 2024), originally designed for physical education, and reimagined here for judo.

METHODOLOGY AND THEORETICAL BACKGROUND

The workshop restricts communication in each dojo to a single mode—voice, movement, symbols, or peer cooperation—highlighting the need for multiple means of representation, a central principle of the Universal Design for Learning (UDL) framework (Lieberman et al., 2020). By deliberately limiting communication, participants experience frustration and confusion that simulate the barriers learners with IDD may face (Sáez-Gallego et al., 2023). Experiencing these challenges firsthand fosters empathy and deepens teachers' understanding of the necessity of varied instructional strategies. This design reflects embodied pedagogy, where knowledge is constructed through both the body and the mind (Nguyen & Larson, 2015). Physical and emotional involvement ensures that teachers not only cognitively recognize but also feel the challenges learners may encounter. At the same time, the activities are structured as cooperative tasks, requiring collaboration and interdependence, which is consistent with evidence that cooperative learning enhances prosocial behavior and inclusive attitudes (Johnson & Johnson, 2014; Fernández-Río & Velázquez-Callado, 2005). The workshop is also grounded in growth mindset theory (Dweck, 2006), encouraging teachers to view ability as something developable rather than fixed. Research shows that teachers with growth-oriented beliefs create more supportive,

cooperative climates and value learner effort (Cai et al., 2024; Griful-Freixenet et al., 2021). In The 4 Dojos, participants first encounter difficulty, then succeed through adapted strategies and teamwork, reinforcing the belief that all learners can progress if instruction is flexible. This directly supports the development of positive attitudes, which are decisive for inclusion: they influence not only the willingness to adapt exercises but also the creation of welcoming and equitable environments (Avramidis & Norwich, 2002; de Boer et al., 2011).

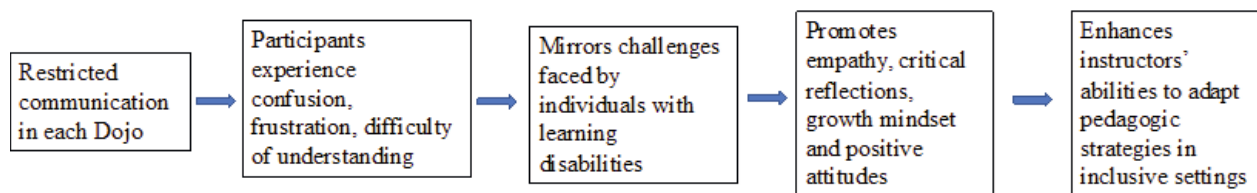


Figure 1: The 4 Dojos: Experiential Learning Process

Finally, the workshop follows the principle of “Nothing about us without us” (Charlton, 2000). In the pilot, a youth leader with IDD co-led the activities, ensuring authenticity and shifting the focus from teaching about disability to learning with a person with lived experience. Similar to findings in disability education (Leo & Goodwin, 2016; Maher & Haegele, 2024), his involvement enhanced authenticity, challenged stereotypes, and fostered meaningful dialogue.

Taken together, these methodological elements—UDL’s multiple means of representation, embodied and cooperative learning, growth mindset, and authentic co-leadership—position The 4 Dojos as both a pedagogically robust and attitude-centered intervention for fostering inclusion in judo.

Workshop Description

The workshop begins with a story, illustrated in a comic strip, The Journey of the Four Dojos, which introduces a critical situation requiring participants’ cooperation. The story contextualizes the practical activities and prepares participants for the workshop.



Figure 2: Reading of the motor story (Ljubljana, March 2025)

Participants then rotate through four dojos:

- Dojo of Voice: Instructions are given only through recorded descriptions in multiple languages. For example, participants might hear the biomechanical description of kuzure-kesa-gatame in mixed languages, like French, Dutch, Slovenian, ... forcing them to cooperate to decode the meaning.
- Dojo of Symbols: Floor markers (arrows, hands, feet) guide participants in performing ukemi. With no verbal explanation, initial confusion is common, but collaboration gradually leads to correct execution.
- Dojo of Movement: Leaders demonstrate tasks physically, without verbal cues. Participants must rely solely on observation and feedback through red/green cards (as for other dojos). For example, they might pass objects using sweeping movements (*barai*) while restricted to standing on floor markers.
- Dojo of Cooperation: One partner creates a sequence in *tandoku-reishu* (solo practice), which the other must mirror and later apply with *uke* (partner). Communication is limited to imitation and kinesthetic guidance, highlighting the role of *Uke's* help in judo pedagogy.

Each dojo ends with a hint, which contributes to the final fifth dojo: a cooperative challenge where all participants must perform *osaekomi-waza* (*ground controls*) techniques from the Kodokan Gokyo under a parachute. Music, symbolic cues, and group effort create a celebratory conclusion. The workshop is ideally run with twelve participants (*two teams of six*) and four leaders, ensuring support and feedback throughout.



Figure 3: 5th Dojo illustration (Ljubljana, March 2025)

Pilot Implementation and Feedback

The first pilot took place in Ljubljana (March 2025) during the Erasmus+ project Judo4ID, with participants from Slovenia, Romania, the Netherlands, and Sweden.

Feedback from participants, collected at the end of the workshop, indicated that:

- Participants valued the cooperative and playful nature of the activities.
- Restricting communication methods revealed the importance of varied teaching strategies.
- The comic strip provided a clear and engaging introduction.
- Initial confusion was replaced by teamwork and enjoyment.
- Suggestions included forming smaller groups for greater involvement.

Overall, participants described the workshop as innovative, practical, and enjoyable, with clear implications for inclusive teaching in judo.

Future Evaluation and Implications

The impact of The 4 Dojos will be further examined through the J-TAID survey (Descamps *et al.*, 2025), allowing changes in teachers' attitudes toward inclusion in judo to be measured before and after the workshop. This evaluation will help establish its effectiveness as a practical tool for instructors. What matters most, however, is that participants leave the workshop with more than just an experience of frustration or play. They carry forward a practical lesson: inclusive teaching in judo requires engaging multiple means of communication—voice, movement, symbols, and cooperation—in line with the principles of Universal Design for Learning. By adapting their methods to meet the diverse learning needs of their judokas, teachers can ensure that all athletes, including those with IDD or other learning difficulties, have meaningful access to training. The workshop therefore not only raises awareness but also fosters a shift in coaching attitudes.

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FROM PEDAGOGY TO THERAPY: THE ERASMUS+ PROJECTS EDJCO AND JOY AND THEIR LEADING TO A JUDO-BASED REHABILITATION STUDY FOR PARKINSON'S DISEASE

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ABSTRACT

This report traces the evolution of judo from a pedagogical framework to clinical applications. It documents two key Erasmus+ projects: EDJCO, which established safe judo practice for older adults, and JOY, which expanded this into an intergenerational health model. The report cites a quantitative case study on Parkinson's disease rehabilitation, showing how this clinical intervention stems from these initiatives. By synthesizing project data, this study demonstrates how the IJF Academy's strategy has bridged philosophical concepts and therapeutic outcomes, preliminary evidence suggests that judo could be a potential tool in neuro-rehabilitation.

Keywords: judo, active aging, intergenerational connection, Parkinson's disease, Erasmus+, EDJCO, JOY

INTRODUCTION: THE STRATEGIC EVOLUTION OF JUDO AS A COMPREHENSIVE DISCIPLINE FOR WELL-BEING

Expanding the Do: The IJF Academy's Mandate

The International Judo Federation (IJF) Academy Foundation serves as the educational arm of the International Judo Federation, providing professional education to coaches and standardizing technical knowledge. Its mandate extends beyond competition to diversify judo's global application, based on the discipline's "great adaptability and technical richness" for use in kinesiology, psychology, and public health. This shift from competitive focus to a broader mission drives the research projects and clinical applications in this report, demonstrating judo's value as a tool for societal well-being rather than just a martial art.

A narrative of progression: from conceptualization to clinical application

The progression of judo from philosophy to clinical intervention follows a deliberate process. The IJF Academy's research projects establish foundations for clinical applications. The Parkinson's rehabilitation project emerged from previous initiatives including EDJCO and JOY projects. This report documents the progression and interconnectedness of these projects, analysing the clinical outcomes of this vision. The sections demonstrate how projects built sequentially, leading to a quantitative Parkinson's disease case study.

THE FOUNDATIONAL AND SOCIETAL PILLARS: EDJCO AND JOY

The foundational phase: the EDJCO project (2021-2023)

The first critical step in the IJF's strategic expansion was the Erasmus+ project "EDucating Judo Coaches for Older practitioners" (EDJCO). This 2021-2023 initiative focused on a demographic typically overlooked in judo: the elderly. The project aimed to equip coaches with skills to work safely with older adults, with its foundation in "safe falling for the elderly". This was a critical prerequisite pedagogical and risk-mitigation initiative. By establishing a framework for

teaching ukemi and gentle movements to a vulnerable population, EDJCO laid the groundwork for applying judo to populations with balance or fall risk issues. This led to a kata developed on the Itsutsu No Kata for teaching falls in movement, expressing Kano Sensei's principles of jita kyōei, seiryoku zen'yō: Gensoku No Genkei (Sacripanti 2022), based on natural human movements. Without EDJCO, the Parkinson's rehabilitation study, which relies on these principles, would not have been feasible from a safety perspective.

The societal phase: the JOY project (2024-2026)

Building on the EDJCO, the Erasmus+ project "Judo Connecting Older and Younger Generations" (JOY) expanded from focusing on older adults to an intergenerational approach. The JOY project (2024-2026) aims to raise awareness of intergenerational judo's importance for the physical, social, and psychological well-being of both age groups. Its goals include research, awareness-raising, and developing e-learning platforms and educational programs. The project held transnational meetings across Europe to disseminate its work. A documented link connects JOY's social aims to the clinical intervention for Parkinson's disease. The project's website shows evidence through a transnational meeting in Portorož, Slovenia, where Dr. Attilio Sacripanti presented on "Parkinson and JOY as Possible Friends," demonstrating that using judo for Parkinson's rehabilitation was conceptualized within the JOY framework also.



Fig1 Erasmus + Projects, Official Logos

Project Name	Project Dates	Primary Aims	Key Output/Deliverables	Contribution to Strategic Progression
EDJCO	2021-2023	Educating Judo Coaches for Older practitioners; promoting safe falling and physical activity for the elderly.	Educational curriculum and materials for coaches; establishment of pilot groups.	Established the foundational pedagogical and safety framework for applying judo to vulnerable populations.
JOY	2024-2026	Fostering intergenerational connections; promoting physical, social, and psychological well-being for all ages.	E-learning platform; scientific reports; transnational meetings and events.	Expanded the scope to a public health model; provided a direct platform for the dissemination and development also of the Parkinson's clinical study.
Parkinson's Project	N/A	Applying a specific judo kata as a therapeutic tool for PD rehabilitation.	A quantitative single-case study; a report on the protocol and results.	Offered preliminary single-case evidence, that the pedagogical and social frameworks established by the preceding projects can yield interesting therapeutic outcomes.

Tab 1. Judo aims, evolution in projects

METHOD

Both projects include ethical approvals: EDJCO: The Institutional Review Board of University of Rome Foro Italico approved the study (*CAR73/2021 on 20 February 2021*).

JOY: The research followed ethical compliance with the Declaration of Helsinki, approved by the IRB of the University of Rome 'Foro Italico' (*CAR 202/2024*), date: 31/05/2025. They used a participatory multi-country approach involving judo coaches, older adults, youth, and academic partners. EDJCO uses a top-down approach, coordinated by Foro Italico Rome University; JOY uses a bottom-up approach, organized by Judo Club Rijeka.

EDJCO: Conducted needs analyses via focus groups (*Palumbo et al., 2023*), developed a multilingual curriculum, and produced safety guidelines for older practitioners (*Ciaccioni et al., 2024*) interviewing In total, 470 international (*Europe = 48%, Americas = 22%, Africa = 23%, Asia = 5% and Oceania = 2%*) judo coaches (*IJF: level 1 = 55,3%, level 2 = 33*) judo black belt: $3,4 \pm 1,7$ dan;

JOY: Implemented intergenerational judo sessions combining training with social interaction (*Ciaccioni et al., 2024*).

Parkinson's Application: Created in the final phase of the EDJCO, it provides adaptive exercise routines, safety protocols, and progress tracking features, based on sports science principles. The study, which involved twice-weekly exercise for three months and follow-up tests at one and three months, produced very interesting results. (*Sacripanti 2022; Sacripanti et al., 2024 Sacripanti, Galea, Fabbri 2025*).

Both projects used participatory design with judo coaches, older adults, and youth, including pre- and post-intervention assessments, surveys, interviews, and practical sessions.

RESULTS

- Physical Benefits: Projects showed improvements in balance, coordination and fitness among older participants (*Palumbo et al., 2023; Ciaccioni et al., 2024*).
- Social Outcomes: JOY sessions enhanced empathy and community cohesion between generations (*Ciaccioni et al., 2024*).
- Parkinson's Application: Testing showed improved motor control and reduced anxiety for regular activity (*Sacripanti et al., 2025*).
- Educational Impact: EDJCO curriculum was adopted by European judo federations, with positive coach feedback (*Ciaccioni et al., 2024*).

DISCUSSION

The projects indicate that judo is adaptable to diverse ages and health conditions, offering physical and psychosocial benefits. Intergenerational practice reduces social isolation, while Parkinson's applications extend martial arts into therapeutic contexts. Challenges included ensuring participant safety, maintaining engagement, and integrating new methods into traditional training.

CONCLUSIONS

EDJCO and JOY show the potential of combining martial arts with modern educational methodology to address aging society needs. The Parkinson's application pioneers therapeutic judo adaptation. Future studies should focus on scaling these models and integrating them into health and educational strategies.

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INTERPRETING YOKO-UKEMI FROM A BIOMECHANICAL PERSPECTIVE, CONSIDERING SAFER FALLING BY OLDER ADULTS

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ABSTRACT

This paper explores the biomechanics of ukemi in judo, focusing on its application to fall prevention in older adults. Building on prior research, it presents an integrated analysis of yoko-ukemi using 14 biomechanical concepts. The study supports global initiatives promoting safer falling techniques through judo within ageing populations.

This paper explores key biomechanical and physical concepts of mass, distance, area, time, velocity, acceleration, momentum, pressure, and balance, in the context of safer falling for older adults, with a focus on yoko-ukemi. It examines how body characteristics such as height, weight, and body surface area influence fall dynamics and injury risk. The role of centre of mass, equilibrium, and kuzushi in judo is discussed to highlight how judoka manage falls effectively. Newton's laws are briefly introduced to frame the mechanics of falling. By applying judo principles, this research supports safer fall strategies for the ageing population.

Keywords: *ukemi, safer falling, biomechanics, balance*

INTRODUCTION

Proper execution of ukemi is vital in judo practice. Increasingly, ukemi is being taught to older adults to help them fall safely. To promote its benefits beyond the judo community, a clear explanation of how ukemi works is necessary. Although some studies explore the biomechanics behind its effectiveness (*Lockhart et al., 2022*), the existing literature is limited. This paper aims to expand the field and support global judo initiatives advocating for safer falling techniques among the elderly population.

This study builds on the author's earlier work in *The Science of Judo (2018)*, focusing on biomechanics, defined as the application of mechanical principles to living organisms (*Innocenti, 2018*), which is key to understanding human movement. Falls among older adults are a costly societal issue (*Fenton, 2014*) and biomechanics offers insight into their causes. In judo, one goal is to unbalance and bring an opponent to the ground (*IJF, 2019*), so judoka are skilled in both initiating (*Daigo, 2005*) and safely absorbing falls using ukemi (*Callan et al., 2022*) making judo a valuable lens for examining elderly falls.

The founder of judo, Jigoro Kano encapsulates the application of biomechanics when he explained the concept of jū, as the first character in the word jūdō:

"Let us say that the strength of a man standing in front of me is represented by ten units, whereas my strength, is represented by seven units. Then as he pushes me with all his force I shall certainly be pushed back, even if I use all my strength against him. But if, instead of opposing him I were to give way by withdrawing my body just as much as he had pushed, remembering at the same time to keep my balance, then he would naturally lean forward and thus lose his balance" (*Kanō, 1932*).

Gunji Koizumi, known as the father of British Judo, linked judo closely with biomechanics, emphasising its reliance on gravity, dynamics, and mechanics. He asserted that analysing judo techniques involves understanding mechanical laws governing human body movement and function (*Koizumi, 1960*).

There is considerable published research relating to the benefits of judo by older adults (*Arkkukangas et al., 2020; Ciaccioni et al., 2021; Jadczyk et al., 2024*). One of the most significant recent papers is the Global Consensus Statement; 'How Can Judo Contribute to Reducing the Problem of Injurious Falls in Older Adults?' published in *The Arts and Sciences*

of Judo which brought together 29 authors from 14 nations, a combination of esteemed academics and highly regarded practitioners including three former world judo champions (*Callan et al., 2024*).

METHODS

Considering the action of yoko-ukemi as a case. A three-phase approach was adopted.

The first phase of the method was to identify the biomechanical concepts that apply to this breakfall technique. The second phase was to analyse the technique using each of these biomechanical concepts. Finally, the third phase was to integrate these analyses in order to produce an integrated analysis of yoko-ukemi.

Phase one: By consideration of the chapter 'Biomechanics of Judo' (*M. Callan, 2018*), 14 relevant biomechanical concepts were identified. For ease of understanding, they were organised into four groups.

Phase two: Yoko-ukemi was considered from the perspective of each of these 14 concepts.

Phase three: The concepts were combined to produce an integrated technical explanation of yoko-ukemi from a biomechanical perspective.

RESULTS

The 14 identified concepts organised into four groups are shown below.

Table 1.

	Fundamental Units	Kinematic Quantities	Balance Concepts	Newton's Laws
Concepts	Mass	Velocity	Centre of Mass	1st Law
	Distance	Acceleration	Equilibrium	2nd Law
	Area	Momentum	Kuzushi	3rd Law
	Time	Pressure		

DISCUSSION

Each concept is discussed below in the context of safer falling and application of yoko-ukemi.

Mass. Mass can be defined the quantity of matter in an object (*Rodgers & Cavanagh, 1984*). The SI unit is the kilogram (*kg*) and in judo, weight categories are defined by mass (*IJF, 2019*). Demographic data shows that among those aged 70 and above, women outnumber men (*Ritchie & Roser, 2024*), with a healthy weight range for a 70-year-old woman being 47–64 kg (*Lifemeasure, 2025*).

Distance. Measured in metres (*m*), distance is significant when assessing how far a person falls. Taller individuals fall a greater distance than shorter ones. For a 70-year-old woman with an average height of 160 cm (*Lifemeasure, 2025*), the relevant distance in yoko-ukemi is from the Centre of Mass (*COM*) to the ground, which is addressed below.

Area. Body Surface Area (*BSA*) is the measured surface area of the human body, calculated as $BSA = 71.3989 \times H.7437 \times W.4040$ where *BSA* is the body surface area in cm²; *H* is the stature height in cm; *W* is the body weight in kg. (*Yu et al., 2010*). In ukemi, distributing impact across a larger surface area reduces injury risk. For yoko-ukemi, approximately 14% of *BSA* contacts the ground during impact (*Callan, 2023*).

Time. In falls research, time is usually measured in milliseconds (*ms*). The time to fall is a combination of reaction time and movement time. Reaction time for 70-88 year-old women was found to be 221 ± 35 ms (*Robinovitch et al., 2005*), while movement time varies ranging from 539 ms to 1170 ms, depending on the situation of the fall.

Kinematic Quantities:

Velocity. This relates to the speed and direction of the fall. $V = d / t$ where *v* is the velocity in metres per second; *d* is the distance in metres and *t* is the time in seconds. The vertical element of the velocity is the speed at which the persons *COM* will travel towards the ground. By introducing a horizontal travel element to the fall, for example during mae-mawari-ukemi, the vertical element of velocity can be reduced.

Acceleration. $\bar{a} = (v - v_0) / t$ where $\bar{a}$ is the average acceleration in m/s^2 ; v is the final velocity in m/s ; v_0 is the initial velocity in m/s ; t is time in seconds. Regardless of mass, a 48 kg person will accelerate due to gravity at the same rate as a 100 kg person, i.e. at $9.80665 m/s^2$ the standard value of gravitational acceleration on earth.

Momentum. $p = mv$ where p is the momentum of an object measured in $kg m/s$; m is the mass measured in kilograms and v is the velocity measured in metres per second. A person that lands on the ground after a fall or ukemi will have a momentum, the value of which depends on their mass and their velocity.

Pressure. Calculated as $P = F / A$ is the force distributed over a given area, where P is the pressure in Pascals (Pa); F is the force in Newtons (N) and A is the area in square metres (m^2). The pressure under the fall is what results in injury, ukemi techniques spread impact across a larger BSA, such as the back or side, reducing pressure and therefore injury risk.

Balance Concepts:

Centre of mass. COM is a theoretical point in an object or objects where its total mass is considered to be concentrated, acting as if all the mass were in that single location (*Carpentier et al., 2017*). In the human body COM is approximately 56% of body height in men and 54% in women (*Ebbeke, 2023*). An average height woman will have a COM which is at 86.4 cm above the ground.

Equilibrium. The state of being on balance. Whereby a vertical line from the COM passes through the Base of Support (BOS) described as the area beneath a person that includes every point of contact that the person makes with the supporting surface (*Base of Support, 2025*).

Kuzushi. An action to unbalance your opponent in preparation for throwing him (*Kawamura & Daigo, 2000*). To achieve kuzushi, judoka are skilled in positioning their uke whereby the COM passes outside of the BOS so they are out of equilibrium and unbalanced.

Newton's Laws:

A detailed description of Newtonian mechanics is beyond the scope of this paper. The accepted definitions are presented below (*Li et al., 2022*).

1st Law. A body remains at rest, or in motion at a constant speed in a straight line, unless it is acted upon by a force.

2nd Law. At any instant of time, the net force on a body is equal to the body's acceleration multiplied by its mass or, the rate at which the body's momentum is changing with time.

3rd Law. If two bodies exert forces on each other, these forces have the same magnitude but opposite directions

CONCLUSION

These concepts are combined when performing yoko-ukemi and can be taught to an older person in order to fall safely. Bending the knees reduces height and so brings the COM closer to the ground. Falling at an angle rather than vertically, takes advantage of the vector element of velocity in contributing to the momentum. Taking longer to impact the ground, by rolling means that the distance travelled is further and the speed of fall is reduced. Landing on a larger proportion of BSA distributes the pressure significantly.

In this way the principles of judo and biomechanics combine to encourage safer falling and contribute to society.

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USHIRO UKEMI MASTERY FOR SAFE AGING: REAL-TIME AUDITORY FEEDBACK SYSTEM TO IMPROVE FALL CONTROL IN OLDER ADULTS.

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ABSTRACT

Falls represent a major health challenge for older adults. In the martial art of judo, practitioners use ukemi (*a set of controlled falling and rolling techniques, which are fundamental break-falling techniques*) to protect themselves when they hit the ground. By distributing impact safely across the body, ukemi helps prevent injury to the head, neck, and spine. This research focuses on ushiro ukemi, the backward breakfall, which is a highly fundamental technique that trains practitioners to roll smoothly onto their back, while maintaining precise body control and timing. Building on these principles, a camera-based sonification system is presented in this study. It translates ukemi biomechanics into intuitive auditory feedback, allowing users to hear their fall technique in real time. Using MediaPipe pose estimation, the system tracks key body landmarks on each side of the body at 30 frames per second, detecting when each crosses a calibrated threshold representing the tatami surface. Each contact triggers a specific musical note, and correct sequential timing produces an ascending melodic pattern. The system supports the traditional seven-level ushiro ukemi progression (*that involves lying, sitting, squatting, and standing*), in both manual and automatic advancement modes. Unlike pressure-sensor mats or wearable devices, this approach is non-invasive, adaptable across environments, and provides rich spatial-temporal information. The melodic feedback design considers sound's superior temporal resolution and the human ability to perceive melodies as movement gestures, potentially reducing cognitive load while making timing patterns immediately perceptible. This represents the first application of real-time pose estimation with auditory feedback for ukemi training, offering a practical and engaging tool to support safer fall-prevention practice.

Keywords: Judo, Training, Fall prevention, elderly, ushiro ukemi, sonification, MediaPipe, pose estimation, motor learning, fall prevention, older adults, real-time feedback, Max/MSP.

INTRODUCTION

Falls pose a significant health risk across all ages, particularly among older adults, contributing to injuries and high healthcare costs (Masud et al., 2001; WHO, 2021). Recent advances in fall prevention technologies based on wearable sensors have shown promise in reducing fall risk (Jiang et al., 2024). Judo practice emphasizes ukemi, a set of safe falling techniques fundamental for injury prevention (Lockhart et al., 2022). The goal of ukemi is to protect the cranio-cervical region through precisely timed impacts that decelerate the head before ground contact (Lockhart et al., 2022). To develop these skills, practitioners train over the course of seven progressive micro-stages that build technique and confidence (Callan et al., 2023). Although precise timing is key to optimal execution, traditional instructional media (*handbooks*) are limited to static representations (Carvalho, 2010; Bountakis, 2022) that fail to interactively convey temporal information to learners. As a lightweight alternative to AR and VR approaches that enhance visualization and motor learning (Carvalho, 2010; Callan et al., 2022), we introduce a camera-based real-time auditory feedback system that sonifies ushiro ukemi biomechanics. The core concept is that key body part contacts with the tatami trigger piano tones mapped to melodic contours, making the fall trajectory explicitly perceptible. Desirable relative contact timing produces a regular ascending melodic pattern, while timing deviations result in correspondingly deviant melodic patterns. This form of auditory feedback uses sound's excellent temporal resolution (2–5 ms) (Moore, 2012) to clearly convey the dynamics of a relatively rapid movement sequence. Melodies are inherently gestural, allowing immediate recognition of movement quality through sound. Movement sonification through melody could reduce cognitive load, enabling intuitive interpretation of motion data while providing an engaging learning experience (Dyer et al., 2015). We posit that the system's modular, "plug-and-play" design can support adaptable and enjoyable ukemi training across various environments (Zhao et al., 2022).

METHODS

The core design concept aimed to convert the execution of the safe fall technique, known as ukemi, into real-time auditory biofeedback. This was achieved through melodic sonification, which involves mapping the physical impacts of specific body parts to an ascending musical scale. The interaction creates a recognisable melodic pattern when the sequential contacts of the hips (C4), elbows (D4), shoulders (E4), wrists (F4), and nose (G5) occur in the correct sequence. This aims to facilitate the perception of fine temporal dynamics and precise sequencing necessary during complex motor control (Moore, 2012). The use of melodic sonification is advantageous for guiding sequential motor tasks because the pattern specifies the correct ordering of actions, helping to structure and sequence timed actions and enabling the recovery of complex target patterns. By relating spatial or positional information (*body contact progression*) to musical pitch, the melody creates a unified Gestalt, making errors salient and correctable (Dyer et al., 2017).

Figure 1 shows the setup of the real-time feedback loop. The system's hardware includes a 1080p USB camera, a laptop (Intel i5, 8 GB RAM), and audio output, while the software stack comprises Python 3.8+, MediaPipe (v0.8.9+), Open Sound Control (OSC), and Max/MSP 8 for audio synthesis. It employs MediaPipe Pose (Google AI, n.d.) for real-time pose estimation, tracking eleven landmarks (*bilateral wrists, elbows, shoulders, hips, and nose*) at 30 fps in the sagittal plane. Due to the method being camera-based, the threshold needs to be calibrated each time. Three calibration methods determine the tatami threshold: (1) lying calibration averaging y-coordinates over 2 s, (2) ukemi demonstration capturing minimum y-values, and (3) manual instructor-guided positioning. The system maps musical notes to body parts (*hips (C4), elbows (D4), shoulders (E4), wrists (F4), and nose (G5)*) such that correct ground contact sequences produce a clear ascending melody. Notes sustain for 500 ms with piano timbre. The system is based on the seven-level progression based on traditional ukemi pedagogy (Carvalho, 2010, Judo Club Rijeka, 2022). However, only two of the progressions are implemented in the first prototype, sitting and standing ushiro ukemi. Correct technique determination drew on expert judoka demonstrations (*demonstration performed by Sune Aagaard Pedersen, 4th Dan black belt, Vice President of the Danish Judo Federation*) and published visual materials (Bradić, 2012). Visual material used as a reference, visual representation of the three calibration methods, demos of the system in action, and extra materials are available in the supplementary folder here.

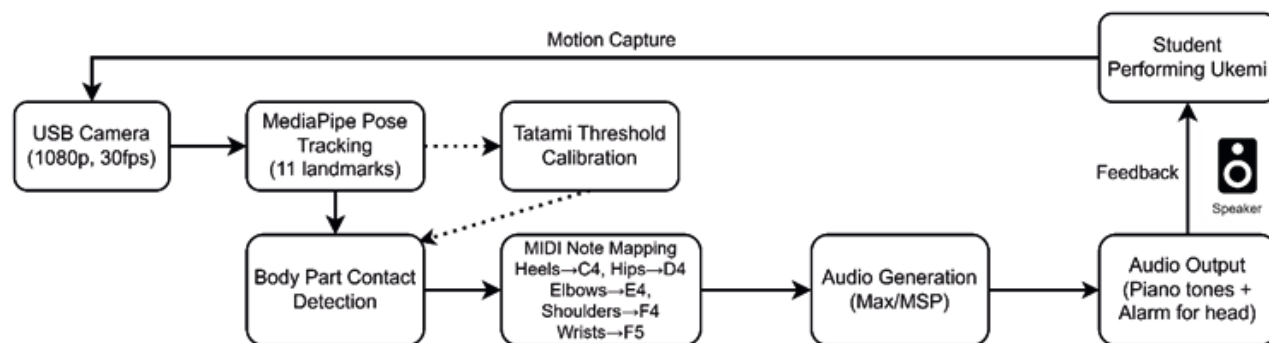


Figure 1. Schematic of the real-time auditory system feedback loop

RESULTS & DISCUSSION

Although the prototype is pending evaluation, the robustness of the interaction concept is supported by literature on motor learning, biomechanics, and auditory perception (Dyer et al., 2015). Movement sonification, the real-time conversion of motion data to sound, has been increasingly investigated as a tool to augment motor learning and enhance motor control for complex movements, often explored in rehabilitation and sport (Schaffer et al., 2019). Auditory and musical biofeedback approaches take advantage of the auditory system's fine temporal resolution and the power of music to motivate and mediate movement to enhance sensory feedback for motor learning (Dyer et al., 2017). By meaningfully encoding task-relevant movement information in a timely manner through sound (Roddy et al., 2018), these methods enhance the acquisition and retention of complex motor skills (Dyer et al., 2015). The system is designed with older adults in mind, aligning with contemporary fall-prevention strategies, as falls in older people are a major public health concern (Masud et al., 2001). Through structured practice, individuals can develop strength, confidence,

and the freedom to remain active without fear of falling. Like fall-prevention initiatives such as I Bedste Fald in Denmark, which combines balance, cognitive, and reaction training to teach safe falling. The system offers a holistic, motivating, and low-cognitive-load learning experience (*I Bedste Fald, 2025*).

The system concept can be adapted to both professional and home settings. In professional environments such as judo dojos, physiotherapy clinics, and community fall-prevention programs, instructors can use it to provide objective, real-time feedback during supervised training sessions. For home use, the long-term vision is to develop a mobile application that requires only a smartphone or tablet camera, eliminating the need for specialized equipment or technical expertise. This would enable older adults to practice independently in their living spaces, with the app providing immediate auditory guidance on their technique. The mobile version could include progress tracking, personalized difficulty adjustment, and remote monitoring capabilities for caregivers or healthcare providers. By making the technology accessible and portable, the system aims to support long-term practice that builds confidence and reduces fall-related injuries in everyday life. This dual-setting approach ensures the system can serve both as a clinical training tool and a sustainable home-based fall-prevention intervention. Limitations of the present work include that the current prototype only addresses contact timing and does not evaluate full-body kinematics, alignment, or context-specific ukemi selection during dynamic scenarios. Over-reliance on auditory feedback could limit internal kinesthetic awareness; thus, training should alternate between feedback and self-guided practice.

CONCLUSION

We have introduced a real-time sonification system for ushiro ukemi training that converts safe falling biomechanics into intuitive auditory feedback. Using pose estimation and melodic sonification, it delivers immediate, objective feedback on body contact timing, which is crucial for preventing head and neck injuries. The system is non-invasive, computationally efficient, conceptually straightforward, and adaptable across the seven ukemi levels. It can serve as a cost-effective training tool for judo instruction and fall-prevention for older adults. Future work includes validation with target groups (*older adults, beginners, rehabilitation patients*) to evaluate learning, confidence, and retention. Planned upgrades involve multi-camera tracking, machine learning-based error detection, and expansion to other ukemi types and force integration. This is the first real-time pose estimation-based auditory feedback system for ukemi, and we believe it can considerably augment training practice, contributing to a safer future for older adults.

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HEAD DIVE IN JUDO CAUSATION AND PREVENTION

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ABSTRACT

“Techniques using head diving are dangerous and will be penalised with hansoku-make. Following the safety frame of judo, performing judo throws should be done without the head going directly to the tatami. The neck is not a very strong part of the body. Landing first on the head with the opponent behind puts athletes at risk and in a very dangerous situation” (*International Judo Federation [IJF], 2023*).

A head dive is typically, (*but not exclusively*) seen where uchi-mata is attempted without effective kuzushi, (*unbalancing an opponent*) combined with lack of rotation during tsukuri, (*positioning to throw*) and kake, (*throwing execution*).

Pharrell et al. (2024) illustrate the safe practice of judo and highlight the dangers of poor execution.

Keywords: *Coaching judo, Safety, Brain function, Head dive.*

INTRODUCTION

Why is this dangerous in judo but not in other sports?

A “head dive” in individual dance or gymnastic sports is less likely to result in injury compared to judo and other contact sports, e.g. rugby. This is because the opponent, (*Uke in judo*) may add significant impetus and force to the downward pressure on the neck which increases the risk of spinal injury. Kodokan Judo was developed to limit the risk of injury while enabling a full contact activity with many physical, mental and educational benefits. The head dive goes against this principle and quite rightly results in a penalty up to and including Hansoku-Make, (*disqualification*) for the protection of Tori, (*the person executing the throw or technique*).

Previous studies have suggested the need to revise training protocols due to the number of injuries in judo training and competition. Previous studies have also suggested that head dives could be caused by judoka going against the advice of coaches. We would suggest that revised training protocols are needed, however the head dive is an unintended result of judo coaching methods. The potential danger is clear and described by Nakanishi et al. (2021).

This review hopes to provide evidence that illustrates the cause, scientific understanding and solution so we can make changes to training methods and reduce head dive injuries.

What is the cause of a head dive in judo?

Although occasional unintentional errors can occur during the intense physical activity of judo, we are witnessing far too many disqualifications in judo competition with the possibility of serious or permanent injuries.

Re-evaluation through “fresh eyes” is always recommended in science, education, work, sport, relationships, in other words all aspects of life. For the basic process of learning judo we can look at the method of uchi-komi, (*repetitive practice*) training in judo. Repetition of movement has been the cornerstone of judo skills development since its inception. Many coaches call this “muscle memory” which is scientifically incorrect, however the basic principle of their intention is correct. So by repeating a safe and effective “action”, we hope to be able to execute this judo technique safely and effectively while under pressure in shiai.

But what if our uchi-komi is for a head dive?

This may sound ridiculous when seen in this context, yet we see this around the world in most judo training sessions. Why would any coach advocate training for a disqualification let alone initiate the practice of head diving yet this is what we observe. We ask coaches to look at the matter with an open mind and fresh eyes.

METHODS

Let's first understand how the process of uchi-komi and randori works in the human body. The brain sends an electrical and or chemical signal to muscle fibers causing them to contract. This is a fundamental concept in basic school science.

But what causes this brain activity and how did it get there?

A part of the brain named the hippocampus is thought to be where memories are initially stored. A new experience from any of the senses will activate the hippocampus during waking hours, or even while dreaming. This process makes the brain a very busy place. These experiences may then be stored as "memories" in other parts of the brain. Judo memories are likely stored as a co-activity of neurons across different areas due to the complex, multidimensional nature of judo. Information between neurons is passed through electrical impulses called action potentials. When memories are being formed, synapses between neurons that are active at the time will dominate other weaker or less used synapses. In this way we have a hierarchy of memory recall and subsequent physical action in relation to judo activity. This combined with the so called, "fight or flight" response results in a specific action from the brain to muscle fibres. This has nothing to do with what is commonly called "muscle memory" which is a function of mitochondria. To put this process into the context of judo development, Uchi-komi becomes the repeated process of building robust, dominant neural synapses. The ultimate aim is to deliver a fast and effective response to a judo stimulus while under physical and mental pressure of shiai via the dominant synapse route created by uchi-komi and randori, (*free practice*). Ultimately this is the biological process to develop and deliver seiryoku zenyo, (*maximum efficiency with minimum effort*). The role of the judo coach is crucial for the production of these synapses during judo training (Marcora & Sarkar, 2018; Babiloni et al., 2010).

DISCUSSION

How can judo coaches help prevent head dives?

An experienced sports coach should be able to view their coaching methods critically from various angles. This often requires coaches to stop, look and re-evaluate our coaching habits and processes. Self-evaluation can often be challenging for coaches due to the nature of the role.

Let's get to the sharp end of judo head dive causation.

Any methodical, repeated movement requiring the head and spinal column to be in a downward motion directly inline and towards the ground where the head is in danger of impact. This is not the same as the end-result, i.e. definition of a head dive, but a definition of causation.

The most common example of "head dive uchi-komi" can be seen regularly during club and squad judo warm up sessions. A gymnastic handstand to forward roll.

Or, looking at this another way, a head dive uchi-komi. We should now understand why this is just asking for trouble in the form of potential permanent injury and / or disqualification.

Argument for current methods?

If it's good enough for a judoka like Shoehi Ono then I should be able to coach it.

Argument against?

To children or any judoka with a fraction of the instinctive last second rotation exemplified by Ono?

We would suggest that is taking a massive risk when there are equally effective, safe alternatives.

RESULTS

Never allow judoka to tuck their head under in training. Always instill rotation and understanding of the direction of throw from day one novice to full time competitive adult judoka.

e.g. a handstand to judo shoulder roll, (*Mae Mawari Ukemi*) NOT the common practice of handstand to head dive gymnastic forward roll. See the images below.

CONCLUSION

Some simple changes to warm up exercises and judo practice will result in brain messages instructing muscle fibers to contract under the pressure of judo competition, (*Shiai*) to form shoulder, neck and head rotation away from danger. These rotation repetitions should be started early for all novice judoka. Where coaches are making changes for current judoka who may have formed a habit of head dive in their judo routine, an explanation of the change will be necessary together with enough repetition to overwrite existing head dive responses.

Handstand to head dive.



Handstand to shoulder roll.



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JUDO FOR SENIOR WELLBEING: FROM LEARNING TO FALL SAFELY TO TRAINING BALANCE FOR FALL PREVENTION AND FIGHTING ‘FEAR OF FALLING’ PATHOLOGY.

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ABSTRACT

This professional viewpoint presents the outcomes and reflections from an ongoing initiative aimed at promoting physical and psychological wellbeing among senior citizens in Malta through the practice of adapted Judo. Since 2022, more than one hundred participants have joined the programme across three University of Malta U3A courses and weekly sessions organised with the Swieqi Local Council 65+ Programme. The experience confirms that Judo offers a holistic and safe system of physical education that improves balance, posture, and confidence in older adults. Beyond learning to fall safely, participants benefit from training balance to prevent falls, building trust in their movement, and rediscovering the joy of physical expression. This paper integrates scientific insights with practical coaching experience to support the inclusion of Judo-based balance education in community health programmes for older populations.

Keywords: *Judo, seniors, balance, fall prevention, wellbeing, physical activity, ageing*

INTRODUCTION

Falls are among the leading causes of injury and loss of independence in adults over sixty-five. According to the World Health Organization (2021), one in three people over sixty-five experiences at least one fall every year. Preventing falls requires not only physical conditioning but also confidence, coordination, and awareness of movement. Judo, as a traditional martial art created by Jigoro Kano, emphasises balance (*kuzushi*), controlled movement, and respect. These principles align closely with the needs of senior wellbeing.

Through the University of Malta U3A and the Swieqi Local Council 65+ programme, adapted Judo sessions were introduced to address both the physical and psychological dimensions of ageing. The initiative explored how Judo can be used not only to teach safe falling techniques but also to prevent falls through balance-focused training and cognitive engagement.

METHODS

Between 2022 and 2025, approximately 100 adults aged between 60 and 82 years participated in weekly or biweekly sessions. Each cycle included an eight- to ten-week programme combining balance training, mobility, and safe falling instruction. Sessions were

held in three U3A localities—Valletta, Mosta, and Paola—and an ongoing weekly class in Swieqi. Each session lasted 75 to 90 minutes and was structured as follows:

- Warm-up and joint mobility exercises
- Static and dynamic balance drills (single-leg stance, tandem walking, shifting weight)
- Fundamental Judo postures and movements adapted to seniors' comfort levels
- Introduction to ukemi (safe falling) with progressive floor techniques
- Partner exercises emphasising mutual respect and communication
- Cool-down stretching and breathing awareness

Observational notes and participant feedback were used to evaluate perceived improvements in balance, confidence, and enjoyment. No quantitative measurements were taken, but qualitative observation and repeated participation indicated functional and motivational gains.



RESULTS

Participants demonstrated noticeable improvements in postural control and coordination after several weeks of practice. Many reported greater confidence in everyday activities such as walking, climbing stairs, or standing up from a chair. A common observation was a reduction in the fear of falling, achieved through progressive exposure to controlled descent and recovery movements. Several participants with mild balance difficulties or sedentary backgrounds expressed renewed enthusiasm for movement. The combination of balance exercises and social interaction appeared to reinforce both physical and emotional wellbeing.

From a biomechanical perspective, regular practice improved proprioceptive awareness— the ability to sense body position in space. This supports existing literature linking martial arts to enhanced neuromuscular coordination in older populations (*Krstulović, 2018*).

Moreover, engagement in Judo drills stimulated cognitive processing related to reaction time, attention, and decision-making, complementing studies on exercise and cognitive ageing (*Callan et al., 2021*).



DISCUSSION

The findings highlight the dual value of Judo as both a preventive and therapeutic approach for seniors. Unlike traditional fitness classes, Judo integrates mental concentration with movement efficiency. Participants must anticipate and respond to shifting balance, which strengthens both neural and muscular coordination. This type of complex motor learning has been associated with maintaining cognitive flexibility in ageing adults (WHO, 2021).

Equally important are the psychosocial benefits: the dojo setting promotes mutual respect, equality, and encouragement, creating a safe environment for self-discovery.

For instructors, the challenge lies in adapting traditional Judo methodology to older adults without losing its essence. Progressive instruction—starting with seated balance work, moving to standing drills, and eventually to controlled falling—proved effective. The tatami environment provided physical safety and psychological reassurance. Most notably, the principle of 'mutual welfare and benefit' (*Jita Kyozei*) came alive as participants helped one another, reinforcing community connection.



PRACTICAL IMPLICATIONS

The implementation of adapted Judo for older adults requires cooperation between sport organisations, local councils, and health educators. Community-based initiatives like those conducted with the University of Malta and Swieqi Local Council demonstrate that minimal resources are needed to achieve significant impact. A soft mat area, patient instruction, and an emphasis on respect and safety are the foundation. The programme can be replicated by other martial arts coaches through short training modules on ageing physiology and risk management.

CONCLUSION

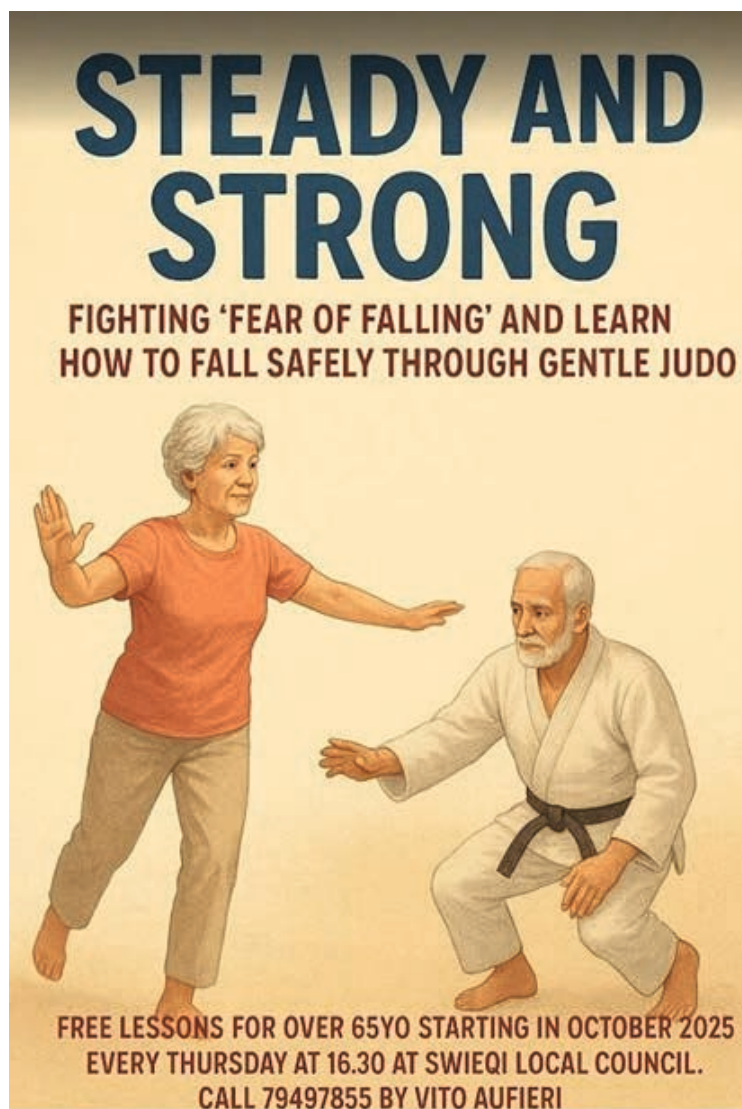
Judo provides an effective model for lifelong learning and active ageing. By merging traditional martial arts philosophy with modern principles of geriatric fitness, it enables seniors to regain confidence, mobility, and social connection. As populations age globally, incorporating adapted Judo into community programmes could significantly reduce fall risk and promote overall wellbeing. Future development of this initiative may include formal balance testing, longitudinal studies, and collaborative research with universities and health agencies.

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2025 New programme



JITA KYOEI AS THE BRIDGE BETWEEN TRADITION AND EDUCATION IN MODERN JUDO

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ABSTRACT

The principle of Jita Kyoei (*mutual growth and development*), formulated by the founder of judo, Jigoro Kano, constitutes one of the fundamental principles of judo. It transcends the boundaries of sport and functions as a universal ethical guideline.

This article analyzes the philosophical roots of this principle, the ways in which it is manifested, or neglected, in contemporary competitive judo, and the possibilities of reintegrating it as an educational tool.

The article also examines the Moral Code, which attempts to serve as a substitute for Jita Kyoei, and explains why it cannot replace it.

Special attention is devoted to the projects Jita Kyoei 1 and Jita Kyoei 2, which represent the practical implementation of values within a pedagogical framework. These projects enabled the definition of four new values, the development of a methodology for teaching values, the design of a curriculum and teaching plan, as well as a hierarchy of teaching titles. The article highlights the significance of these results for contemporary judo and proposes further development within the framework of Jita Kyoei 3.

Keywords: *Judo, Jita Kyoei, Moral Code, Jigoro Kano, education, teaching values, project implementation*

INTRODUCTION

Judo is much more than a sport. Its founder, Jigoro Kano, conceived it as a comprehensive system of physical training, intellectual development, and moral education. He designed judo as an educational method grounded in the principle of Jita Kyoei (*mutual prosperity and growth*). This principle transcends the boundaries of sport and functions as a universal ethical guideline.

While the concept of Jita Kyoei is often mentioned in judo philosophy, few studies have systematically explored how it can be translated into pedagogical practice and moral education today.

This article seeks to address the following question: How can the principle of Jita Kyoei once again become a carrier of education in modern judo, and how can it be taught methodologically? Today, judo is often understood primarily as an Olympic sport, where medals dominate. In this process, Kano's original vision of judo as an educational tool leading the individual and the community toward holistic development has been partially lost.

As a counterbalance to the sportification of judo, French masters formulated the Moral Code, intended to introduce young judoka to the moral dimension of the sport. However, analysis has shown that the Moral Code is too narrow and does not reach the breadth of Jita Kyoei.

Contemporary theories of moral education (*e.g., Shields & Bredemeier, 2001*) emphasize that values in sport should be taught intentionally, not left to chance or imitation.

For this reason, it is necessary to reopen the discussion on the significance of Jita Kyoei and to reconsider it in the context of modern sport and education. The purpose of this article is to demonstrate that Jita Kyoei is not merely a historical maxim, but can also today serve as a fundamental carrier of education in judo, provided it is properly understood, taught, and integrated into practice.

The article presents practical solutions for teaching the values of Jita Kyoei. To this end, the Moral Code has been expanded with four new values. The main empirical examples are drawn from the Erasmus+ sport projects Jita Kyoei 1 and Jita Kyoei 2, as well as from the draft project Jita Kyoei 3.

METHODS

The methods applied in this study were chosen to explore how the original principle of Jita Kyoei can be reinterpreted and applied within contemporary judo pedagogy.

An important part of our research consisted of a literature analysis. Through it, we wanted to determine the exact meaning of the slogan Jita Kyoei and the process through which Jigoro Kano arrived at this idea. We used the works of Western judo experts who translated Kano's original writings and drew information from sources of the Kodokan Museum in Tokyo. In addition, we examined the reasons for the creation of the Moral Code and researched when and in what way it was formulated. In doing so, we relied on the works of French authors and on materials from leading judo organizations – the European Judo Union (*EJU*) and the International Judo Federation (*IJF*).

We also included in the research materials prepared within the Erasmus+ sport projects Jita Kyoei 1 and Jita Kyoei 2. Within these projects, we carried out seminars and presentations on teaching values through judo in seven countries (*Portugal, France, Italy, Slovenia, Croatia, Hungary, and Romania*). A total of 157 judo coaches participated in these educational activities. These coaches were not directly included in the research; instead, we taught them how to teach values through judo. Based on our observations and informal conversations during the seminars, we gained valuable insight into how coaches understand and apply the principles of Jita Kyoei and the Moral Code in their pedagogical practice.

Based on these experiences and reflections, we later began developing a questionnaire to explore in more detail how well coaches know the principle of Jita Kyoei and whether and in what way they teach values through judo. The questionnaire (*which, at the time of writing this paper, had not yet been completed*) will be sent by e-mail to our judo coaches with whom we cooperated in the mentioned projects.

The findings of these analyses and future data collection will be used in the development of the conceptual model Jita Kyoei 3, which will represent an innovative pedagogical approach to teaching ethics through judo practice.

RESULTS

We analyzed the meaning of the principle of Jita Kyoei and compared it with the French Moral Code, which was later adopted by both the EJU (www.eju.net) and the IJF (www.ijf.org) as an educational method for young judoka.

Jigoro Kano described Kodokan Judo as an educational method founded on the ethical principle of Jita Kyoei. He was guided by the idea that an individual must develop in all aspects: physical, intellectual, and moral, represented by the Japanese expressions *Reitai ho* (*body*), *Shobun ho* (*mind*), and *Shushin ho* (*spirit*).

In 1886, the Japanese Minister of Education, Mori Arinori (*Gatling, 2021*), convened a group of six experts and intellectuals, among whom was Kano. Their work was primarily grounded in the philosophy of Herbert Spencer's Education: Intellectual, Moral and Physical. The group produced a 90-page book on education, which included the slogan *Jita heiritsu* (*"self and others standing side by side"*).

Kano himself translated Jita Kyoei as "mutual welfare and benefit" (*Erasmus, Jita Kyoei, 2021*). He arrived at this final formulation through a series of derivations: *Jiko no kansei* (*self-perfection*), *Ta no kansei* (*self-realization through the realization of others*), and *Jinrui kyoei* (*the flourishing of humanity*) (*Cunningham*).

On this basis, Kano articulated the slogan Jita Kyoei: *Ji* (*self and others*), *Kyo* (*mutual, reciprocal, shared*), and *Ei* (*success, growth, prosperity*). Summarized, this means "mutual prosperity and benefit" or "mutual growth and development." A more precise translation could be "mutual prosperity through my efforts and the efforts of others."

For Kano, Jita Kyoei was the ultimate goal of personal development for every individual. He believed that society is composed of individuals and that the only way for society to progress is through the growth of its members. As he stated: "If we wish to make a meaningful contribution to the development of society, we must first improve ourselves."

Kano argued that education must be the lifelong goal of the individual, but life itself must also be oriented toward the benefit of society. He went so far as to claim: "If an individual is not useful to society, his life has no meaning." From this he derived the ultimate goal of judo: "to cultivate a self-realized individual who, with his knowledge and experience, contributes to the growth of society."

Mutual influence, however, also generates mutual responsibility. The individual's first responsibility to society is to take care of oneself (Cadot, 2014). From this, Cadot concludes: "The individual must be placed at the center of a triangle, whose sides are personal aspirations (*individual goals*), abilities (*applied effort*), and social needs."

Values derived from jita kyoei

Based on the analysis of the slogan Jita Kyoei, we identified four key values:

- Self-realization: the life goal of improving oneself (Jiko no kansei),
- Proactivity: contributing to the growth of society through one's knowledge and experience (Jinrui kyoei),
- Responsibility: acting for the benefit of society, acknowledging mutual influences and mutual responsibilities (Ta no kansei),
- Trust: when I benefit, the other also benefits = reciprocity; genuine growth is only possible through cooperation (Jita).

To this, it is necessary to add Zen (*good*) from the principle of Seiryoku zenyo, since actions must aim at the good of all, not merely at the advantage of particular groups.

Analysis of the moral code

Bernard Midan, a French judo master, together with his colleagues, created the Moral Code of Judo. With this, they initiated a campaign to raise coaches' awareness that judo is more than the pursuit of medals. Midan was disappointed with the sportification of judo, as he believed that competitive judo was drifting away from Kano's original foundations and even returning to ju-jitsu (Brousse, 2021).

The Moral Code consists of eight values. The choice of the number eight was likely deliberate, as in Asian culture it symbolizes good fortune, while the horizontal figure eight also represents infinity. The Moral Code was officially presented in 1985.

Midan derived some of these values from the samurai code described by Inazo Nitobe in *Bushido: The Soul of Japan*. Nitobe explains how, in feudal Japan, vassals and professional warriors (*samurai*) were educated (Nitobe, 1991). The samurai was a professional soldier who had to obey his lord and was expected to die for him out of honor.

The values described in the book include justice, courage, benevolence, politeness, truthfulness or sincerity, honor, and duty or loyalty. Four of these (*courage, politeness, sincerity, honor*) were incorporated into the Moral Code, to which humility, respect, self-control, and friendship were added.

Limitations of the moral code

Although the Moral Code encompasses certain dimensions (*e.g., respect, sincerity, courage*), it remains too narrow to capture the full meaning of Jita Kyoei.

The reasons are as follows:

- It was not designed as a replacement for Jita Kyoei but as a practical pedagogical tool,
- It functions as a simplified solution, since many coaches neither know nor teach the principle of Jita Kyoei,
- Within the context of competition and medals, it provides a more accessible framework but risks obscuring the deeper meaning of judo,
- If Jita Kyoei is replaced by the Moral Code, the essence of judo as an educational method changes, reducing it merely to the behavior of judoka during competition.

The Moral Code as an Invention of Tradition

Midan and his colleagues effectively created a "new tradition." Through discussions, we found that the majority of judoka mistakenly believe that the Moral Code was the work of Jigoro Kano.

Eric Hobsbawm and Terence Ranger, in *The Invention of Tradition* (1983), define invented tradition as “a set of practices, normally governed by overtly or tacitly accepted rules and of a ritual or symbolic nature, which seek to inculcate certain values and norms of behavior by repetition, which automatically implies continuity with the past” (Cunningham).

Judoka have, in a sense, accepted the Moral Code as a substitute for Jita Kyoei because the latter is difficult to understand. It has also been adopted for more practical reasons, such as the appealing posters displayed on dojo walls.

Practical implementation

Other countries (www.judobund.de), following the French example, began creating their own moral codes, and even Japan developed a similar project, MIND.

For this reason, we added four Jita Kyoei values to the eight values of the Moral Code. We developed a curriculum and teaching plan for all twelve values, along with a methodology for their instruction. In addition, we established a hierarchy of teaching titles (*Mediator, Mediator Trainer, Trainer of Mediator Trainers*) and conducted training programs for Mediator and Mediator Trainer certifications in seven countries. All of these coaches will also receive a questionnaire on Jita Kyoei via email.

The results of the Jita Kyoei 1 and 2 projects demonstrate that values can be taught systematically and sustainably, thereby increasing the effectiveness of education and strengthening the connection between philosophy and practice.

Connections with Japanese society

In analyzing the concept of Jita Kyoei, we encountered similar slogans used in Japanese society and corporate culture. The most notable examples include: Kaizen (*continuous improvement, Toyota*), Kyosei (*the spirit of cooperation, Canon*), Ikigai (*a sense of purpose that gives motivation for life*).

DISCUSSION

The results confirm that the principle of Jita Kyoei is often neglected in contemporary judo due to the dominant emphasis on competitive results. The reasons for this are multifaceted: insufficient understanding of Kano's philosophy, cultural differences between Japan and Europe, and the absence of systematic methods for teaching values. The Moral Code, which has been embraced by the judo community as an important tool for educating young judoka, is too narrow to serve as a substitute for Jita Kyoei.

A central problem in the teaching of Jita Kyoei and the Moral Code is the lack of substantive knowledge of these principles among judo coaches. Coaches frequently do not teach Jita Kyoei or the Moral Code because they are unfamiliar with them, do not fully understand them, and lack the pedagogical skills to convey them. A parallel can be drawn with the teaching of judo kata, which are also often neglected because many coaches do not know them. The common justification is that competitive judo does not allow sufficient time for kata practice. In this way, the holistic educational dimension is replaced by a one-dimensional logic of medals, which diverges significantly from the very reasons judo was originally created.

The Significance of the Four New Values

The proposed update of the Moral Code with four additional values makes it possible to expand, clarify, and contemporize the principle of Jita Kyoei. The inclusion of self-realization, responsibility, trust, and proactivity represents an important enhancement of the traditional Moral Code. These values help bridge the gap between Jita Kyoei and the Moral Code. This means that values are no longer transmitted only implicitly or theoretically in the form of short slogans used for belt examinations, but can instead be taught systematically, just like the technical elements of judo.

In this way, the teaching of values in judo becomes a planned, structured, and practically applicable process. It is essential that coaches perceive values not as an unnecessary addition, but as an integral part of every training session.

Remaining Challenges

Challenges persist: how to adequately train coaches in the use of these methods, how to integrate values into existing programs, and how to secure the support of sports institutions. Without institutional support, the implementation of the new model would remain limited.

In this context, the Jita Kyoei 3 project provides an opportunity to test this model in practice. It offers a framework that combines mentorship, institutional support, and promotion through international organizations. With effective promotion and a clearer explanation of what Jita Kyoei is and what it means, the international judo federation could ensure that this slogan becomes recognizable among judoka and the broader public, similar to the well-known concepts of Kaizen, Kyosei, and Ikigai.

With Jita Kyoei as a recognizable slogan, judo would acquire an even stronger educational and ethical advantage over other sports, which lack comparable ethical principles embedded within their disciplines.

CONCLUSION

The analysis shows that Jita Kyoei represents an ideal toward which every judoka, and indeed every individual within society, should aspire. While the Moral Code is a useful pedagogical tool, it is too narrow to encompass the entirety of Kano's philosophy.

The addition of new values, self-realization, responsibility, trust, and proactivity, to the Moral Code allows Jita Kyoei to be translated into a contemporary context and more directly connected with the challenges of modern society. If judo is to once again serve as an instrument of education, values must be taught as systematically as judo techniques, in the form of a "kata of values." This requires coaches to acquire new knowledge, embrace pedagogical approaches, and receive institutional support.

The governing judo organizations, EJU and IJF, should integrate value-based education into coaching licenses. National judo federations should introduce Jita Kyoei modules in coach education programs. Within clubs, the "kata of values" should become a regular part of basic training.

The pilot project Jita Kyoei 3, which foresees a mentoring network and promotion through the IJF Academy and national federations, could serve as a concrete step in this direction.

Ultimately, we return to Jigoro Kano: judo was not conceived as a competition for medals, but as a way of life that educates individuals and brings benefits to the community. Reviving and expanding the principle of Jita Kyoei in modern judo ensures that judo remains faithful to its roots while simultaneously becoming relevant for the future, both as a sport and as an educational tool.

Through focused efforts in explaining and teaching the meaning of Jita Kyoei, judoka can become "bearers of the spirit of Jita Kyoei."

The true spirit of judo is not captured merely in written values, but in people who embody those values. The bearer of the spirit of Jita Kyoei is the teacher, mentor, and role model who, through action rather than words, exemplifies the principle of mutual growth. Such a person uses their strength not for domination but to uplift others. Like a candle that can light another without losing its own flame, the bearer of the spirit spreads values through example.

The spirit of Jita Kyoei: self-realization, mutual benefit, cooperation, collective growth, and responsibility (*toward oneself, toward others, and toward the world*).

The Moral Code is an excellent pedagogical aid that reminds judoka that judo is more than sport. Its shortcomings, however, lie in its inability to match the breadth of the Jita Kyoei principle and in its lack of guidance on how to teach values. This vision was already foreseen by Jigoro Kano's son, Risei Kano, who summarized the educational mission of judo as follows: "In order to save them from this situation, a principle of judo, based on the maximum efficiency concept, should be applied as one aspect of modern society and, as a natural result of the application of the principle of maximum efficiency, a mutual welfare and prosperity is believed to be the only effective way to ease and neutralize the forces among these individuals and organizations."

This reflection reinforces the idea that the essence of judo lies not in victory, but in the creation of a society guided by efficiency, mutual welfare, and peace among people.

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HARNESSING JUDO FOR YOUTH DEVELOPMENT IN HARD-TO-REACH COMMUNITIES: CASE STUDIES FROM UK SCHOOLS AND CLUBS

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ABSTRACT

Combat sports such as judo are increasingly recognised as effective vehicles for supporting youth development, particularly among young people facing disadvantages, behavioural challenges, or social exclusion. This paper synthesises case study evidence from judo-based interventions delivered between 2022 and 2024 across schools and communities in five UK regions (*Clacton, Leicester, Wolverhampton, Surrey, and Perth*). Judo was used as an everyday vehicle for engagement rather than as a controlled experimental intervention. The interventions engaged over 120 children and adolescents (*aged 8–17*) identified as at risk of exclusion, low in confidence, or with limited access to sport. Data sources included attendance and behaviour records, student and staff reflections, and parental testimonies. Findings consistently highlighted improvements in emotional regulation, confidence, peer relationships, and school engagement. For example, one school reported a 75% reduction in suspensions following the programme, while others observed participants joining local judo clubs after initial exposure. The results demonstrate the value of judo as a low-cost, scalable, and inclusive intervention aligned with educational and public health priorities. Importantly, they illustrate how the structured challenge, discipline, and respect embedded in judo can foster resilience and belonging among hard-to-reach youth. These practice-led insights support further co-constructed research into the long-term educational, psychological, and community impacts of judo-based interventions.

Keywords: judo, youth development, emotion regulation, school engagement, case studies

INTRODUCTION

Sport-based interventions are increasingly recognised as tools for improving young people's physical, emotional, and behavioural wellbeing, particularly in disadvantaged communities (*Bailey et al., 2009; Coalter, 2013*). While mainstream team sports dominate provision, combat sports such as judo offer structured, values-driven contexts for personal development through challenge, discipline, and respect (*Vertonghen & Theeboom, 2010*). Judo, founded on *seiryoku zenyo* (*maximum efficiency*) and *jita kyoei* (*mutual welfare and benefit*), provides a unique setting for fostering emotional regulation, confidence, and social skills (*Lakes & Hoyt, 2004*).

Recent frameworks such as Lane's CALM model (*Cultivating Awareness, Learning, and Mastery*) highlight how combat sports can reduce anger and violence by explicitly linking physical challenge with emotional regulation, goal-setting, and resilience (*Lane, 2025*). CALM integrates behaviour change theory, particularly the COM-B model (*Michie et al., 2011*), and mood regulation frameworks (*Beedie et al., 2022*) to demonstrate how structured sport can provide motivation, capability, and opportunity—the three pillars required for behaviour change. This conceptual foundation supports the argument that judo-based interventions can address both individual vulnerabilities (*e.g., emotional dysregulation*) and systemic barriers (*e.g., low access to sport*) by embedding psychological learning within physical practice.

This study aims to synthesise case study evidence from judo-based interventions delivered in UK schools and community settings between 2022 and 2024, in order to evaluate how judo contributes to youth development.

METHODS

This was a retrospective, naturalistic evaluation of judo sessions delivered as part of normal school and community activity. Programmes were not pre-designed as research interventions; rather, data were collated afterwards to understand emerging patterns and shared outcomes. This study used a multi-site case study approach to examine the outcomes of judo-based interventions delivered in school and community settings across six UK locations. Each intervention was independently organised by local school staff, coaches, or development officers, and data was later compiled and analysed to identify shared themes and reported outcomes. The aim was to capture the impact of judo as a behavioural and inclusion-focused intervention for children and young people considered disengaged or underserved by traditional school sport provision.

Unlike a controlled intervention study, this project analysed naturally occurring judo programmes that were already running in schools and clubs. The research team synthesised existing records and reflections after delivery to identify recurring outcomes and mechanisms. This approach prioritises ecological validity and real-world relevance over experimental control.

Settings and participants. Interventions took place in Clacton County High School (*Essex*), Orchard Mead Academy (*Leicester*), Our Lady and St Chad Catholic Academy (*Wolverhampton*), primary and junior schools in Surrey (*via School Games*), and Perth Grammar School/community clubs (*Scotland*). Participants ($n > 120$; ages 8–17) were identified as vulnerable due to behavioural challenges, low confidence, poor attendance, SEND (*special educational needs and disability*), or limited access to sport.

Intervention format.

Judo was used as an everyday vehicle for engagement rather than as a controlled experimental intervention. All interventions used judo as the central delivery mechanism, facilitated by qualified coaches with experience in inclusive and school-based sport. The format varied by site, reflecting the realities of school timetabling, staffing, and community resources. This variability is a strength, as it demonstrates that judo can be flexibly embedded within existing systems — enhancing ecological validity by showing how interventions work under real-world conditions rather than controlled laboratory settings. Techniques practiced included Fundamental Movements, Ukemi (*Breakfalls*), Basic Standing Techniques (*Nage-waza*) and Basic Groundwork (*Ne-waza*)

Delivery modes included:

- Programmes varied between 4–10 weeks, typically involving weekly 45–60-minute sessions within PE or enrichment timetables. All sessions took place on mats with participants in judogi. Activities included warm-ups, ukemi (breakfalls), basic standing throws (nage-waza), and groundwork (ne-waza).
- Participants continued their normal PE and extracurricular activities; the judo sessions were integrated into existing provision.
- Targeted enrichment: Small-group sessions timetabled for children identified as vulnerable (e.g., those at risk of exclusion, with SEND needs, or with poor attendance). These sessions provided focused support within the school day.
- Pastoral and behaviour units: In some schools, judo was embedded within pastoral care timetables, aligning with broader behaviour management strategies.
- Single-day events and festivals: Larger-scale judo taster days and School Games competitions were used to introduce groups of students to judo in an engaging, celebratory context. These often included medals, belts, and certificates, offering visible rewards and immediate recognition.
- Community linkage: Several interventions included pathways into local judo clubs, providing continuity beyond school and reinforcing opportunities for sustained participation.

Connection to COM-B. Ecological validity meant that interventions naturally aligned with the three drivers of behaviour change:

- **Capability:** Students developed physical skills (throws, falls, holds) alongside psychological skills (self-regulation, discipline, emotional control).

- Opportunity: Sessions were embedded into the existing school timetable and supported by trusted adults, meaning students had structured, accessible opportunities to participate.
- Motivation: The use of visible rewards (belts, certificates), relational reinforcement (praise from coaches/teachers), and personal pride in progression fostered both extrinsic and intrinsic motivation.

Connection to CALM. The varied delivery contexts also reflected CALM's emphasis on Cultivating Awareness, Learning, and Mastery:

- Students became aware of their emotions through the immediate feedback of judo practice (e.g., success or failure in a throw).
- They learned strategies for control and persistence within a respectful, rule-bound context.
- Over time, they developed mastery, transferring skills from the dojo into classrooms, friendships, and family life.

In sum, the diversity of delivery formats strengthens the ecological validity of the interventions, showing that judo can be adapted to different educational realities while still engaging the COM-B drivers of behaviour change and following the CALM pathway toward emotional growth and resilience.

In terms of measures, no formal psychometric scales were used. Emotional regulation, behaviour, and confidence were inferred from existing school behaviour and attendance records, teacher and coach observations, and qualitative reflections from students and parents.

Data collection

To enhance rigor and efficiency in our thematic analysis, we used artificial intelligence tools (*large language models / AI-assisted coding*) for initial coding and pattern detection, drawing on precedents such as Holtrop et al. (2024) and Turobov, Coyle, & Harding (2024), who have shown that AI can reliably support initial stages of qualitative data processing while preserving researcher-led theme development. Human oversight was applied to verify AI-suggested codes, adjust context and meaning, and integrate findings into the COM-B / CALM framework.

RESULTS

Findings across sites showed consistent improvements in emotional regulation, behaviour, confidence, and school engagement. Despite methodological variation, the combined results provide strong practice-based evidence of judo's impact in challenging educational settings.

1. Emotional regulation and behaviour. Judo participation was linked with greater self-control and fewer classroom incidents. At Orchard Mead Academy, suspensions fell by 75% among girls and 50% among boys. In Clacton and Perth, teachers described "transformational" changes in attention and peer interactions, while Surrey schools reported better rule-following and courtesy.
2. Confidence and belonging. Students reported increased pride and connection. At Our Lady and St Chad, PE participation among girls rose by 26%. Surrey and Ippon Judo events gave disengaged pupils visible success, medals, and recognition, with some girls continuing judo at clubs. One Surrey case highlighted two brothers whose participation extended to family engagement and aspirations for progression.
3. School engagement. Attendance and punctuality improved. At Orchard Mead, 60% of participants gained at least 5% in attendance; at Our Lady and St Chad, attendance rose from 77% to 88%. In Perth, students previously attending less than half the time began re-engaging with school.

DISCUSSION

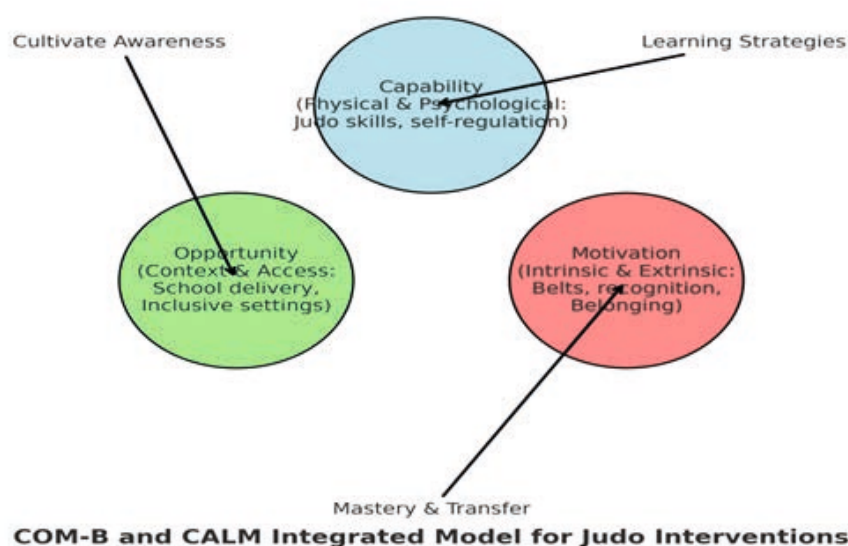
The findings provide compelling evidence of judo's potential as a school- and community-based intervention. Improvements in emotional regulation, confidence, and attendance were observed across diverse contexts, supporting judo as a flexible, values-based tool for youth engagement.

The COM-B model (Michie *et al.*, 2011) offers a structured explanation for why these interventions worked. Judo enhanced capability by teaching both physical skills (*throws, falls, holds*) and psychological skills (*self-regulation, confidence, respect*). It created opportunity by embedding sessions within schools and offering inclusive formats that reached children otherwise excluded from sport. Finally, it increased motivation by providing immediate recognition (*belts, certificates*), visible progression, and a sense of belonging. The synergy of these three elements explains why young people engaged and why behaviour change was observed. This aligns with broader evidence that effective interventions must tackle multiple behavioural determinants simultaneously (Michie *et al.*, 2011; Greenhalgh & Papoutsis, 2018).

The CALM model (Lane, 2025) further illustrates how combat sports interventions cultivate awareness of emotions, foster learning of adaptive strategies, and develop mastery through repetition. Our case study findings mirror these stages: students reported becoming more aware of their emotional triggers, learning to manage them in structured judo settings, and transferring these skills into classrooms and peer relationships. CALM therefore provides both a theoretical rationale and a practical blueprint for scaling such programmes.

These results are consistent with prior evidence that martial arts training can improve self-control and reduce aggression (Lakes & Hoyt, 2004; Lafuente *et al.*, 2021; Vertonghen & Theeboom, 2010). What distinguishes this study is the ecological validity: interventions were delivered in real-world, disadvantaged settings where traditional approaches often fail (Coalter, 2013). This highlights the power of judo as both an accessible sport and a psychosocial intervention.

Figure 1: Integration of the COM-B framework with the CALM model to explain behaviour change in judo interventions.



This study's naturalistic design means there was no control group, pre-post standardised measurement, or consistent data capture across sites. However, this ecological realism strengthens the findings' relevance to everyday educational and community settings. Overall, judo offered a structured, values-based context that fostered confidence, resilience, and positive relationships with school. Its unique combination of challenge, respectful contact, and moral education aligns with behaviour change models such as COM-B (Michie *et al.*, 2011) and CALM (Lane, 2025), emphasising motivation, opportunity, and capability development. These results support embedding judo into school inclusion and wellbeing strategies, while future research should examine long-term effects on resilience, attainment, and sustained physical activity.

CONCLUSION

This practice-led study demonstrates that judo interventions can foster meaningful improvements in emotional regulation, behaviour, confidence, and school engagement among disadvantaged youth. By situating these findings

within the COM-B and CALM frameworks, we illustrate how judo not only engages young people but also builds transferable life skills that reduce risk of disengagement and antisocial behaviour. Future research should co-construct scalable models integrating practitioner expertise with behaviour change theory, and evaluate long-term outcomes in resilience, wellbeing, and academic attainment.

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JUDO WINNER PREDICTION MODEL

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INTRODUCTION

The competitive landscape of modern judo is highly dynamic; therefore, athletes and coaches need tools to forecast outcomes. Traditional rankings like the International Judo Federation (*IJF*) list reward long-term performance but fail to account for recent form or strategic scheduling. To address this gap, a new working model has been proposed that estimates a judoka's probability of winning a match by blending different Key Performance Indicators (*KPI's*). Each factor is normalized to a 0–1 range, and the predicted win percentage is calculated as a weighted sum of these scores. This presentation summarizes the key components of that model and discusses its strengths, weaknesses, and the need for data-driven calibration.

Model Description

The model combines six weighted factors.

- IJF ranking score
- Recent form score (wins / (wins + losses))
- Match points (opponent strength)
- Exposure score
- Elo expected win probability
- Draw factor score

IJF Ranking Score (30%)

The IJF World Ranking List provides a foundation of long-term performance and consistency at the international level. Athletes accumulate points across Grand Prix, Grand Slams, World Championships, and Olympic events, making this the most reliable measure of proven ability.

Although it may not adapt quickly to recent form shifts, weighting it at 30% ensures it remains central while leaving room for dynamic and situational factors.

Recent Form Score (25%)

Calculated as the ratio of wins to total matches over a defined period, the recent form score captures short-term performance and psychological momentum. This KPI prevents the model from overvaluing historical results while ensuring that athletes in strong form are recognized.

Match Points (Opponent Strength) (15%)

This metric adjusts for the quality of opposition faced. Wins against higher-ranked judoka (*3 points*) are weighted more heavily than victories over equal-ranked (*2 points*) or lower-ranked (*1 point*) opponents. This ensures that two athletes with similar win records are differentiated based on the calibre of their opposition.

Exposure Score (10%)

Competition exposure reflects how athletes manage their schedules. Research shows that medal-winning judoka often reduce competition frequency in the months leading up to the Olympics. Evidence from the 2012 London Olympics and the Tokyo 2020 cycle suggests that high win percentages and fewer competitions in the months leading up to the Games are linked with medal success using strategic rest to avoid injuries and maintain peak form. Many elite judokas

also intentionally limit their competition exposure before major championships to conceal tactical details, avoid injuries and allow sufficient recovery.

The competition exposure KPI measures an athlete's strategic exposure in the months preceding the competition. For each athlete, count the number of IJF World Tour competitions contested in the designated time window (*6 months for men, 12 months for women*). Let C_n be the athlete's count and C_{max} the maximum count observed. The KPI is defined as:

$$\text{Exposure Score} = 1 - (C_n / C_{max}).$$

Elo Expected Win Probability (10%) Role of Elo in Reliability

Elo ratings enhance the reliability of the weighting scheme in several ways. First, Elo dynamically adjusts after every match, reflecting athletes' current competitive strength more accurately than static ranking points. Second, Elo is opponent-sensitive: beating a stronger judoka yields a larger gain, while losing to a weaker opponent result in a greater penalty, thereby preventing inflated records. Third, Elo produces continuous win probabilities, making it both a useful feature and a benchmark for calibration. Each factor is normalized to a 0–1 range, and the predicted win percentage is a weighted sum of these scores.

Draw Factor Score (10%)

The draw factor accounts for the influence of tournament structure. A favourable draw (*byes, weaker early opponents*) increases progression likelihood, while a tough bracket reduces it. This KPI ensures predictions are grounded in both athlete ability and practical competition pathways.

Draw Calculation

- Simple Draw is fast and usable as soon as the bracket is published (seed position, byes, earlyopponent quality).
- Path-based Draw sums expected opponent strengths for each round. Before competition, use probabilities to form expected strengths; after competition starts, update deterministically as rounds progress.

Table 1. KPI's weighting.

KPI	Weight (%)
IJF ranking score	30
Recent form score	25
Match points (opponent strength)	15
Exposure score	10
Elo expected win probability	10
Draw factor score	10

$$\text{Predicted Win \%} = 0.30 \times \text{IJF} + 0.25 \times \text{Form} + 0.15 \times \text{MatchPts} + 0.10 \times \text{Exposure} + 0.10 \times \text{Elo} + 0.10 \times \text{Draw} + 0.10.$$

Interpreting and Validating Weights

The percentage weights in the model represent the relative influence of each KPI on the predicted probability of victory. Currently, these weights are heuristically assigned. To make them more reliable, historical data calibration should be applied using methods such as logistic regression or machine learning. Cross-validation and metrics like the Brier score can be used to evaluate calibration quality, while dynamic updates can ensure weights remain accurate across competition cycles and categories.

Integrating Elo into logistic regression with IJF points, form, and other KPIs reduces subjectivity by letting the data determine the optimal weightings. While Elo does not capture strategic exposure or draw effects, it significantly strengthens the model's ability to reflect true competitive ability and capture upsets.

Advantages of the Model

The integrated framework acknowledges that winning matches depends not only on an athlete's long-term ranking but also on current momentum, the strength of recent opponents, strategic scheduling and draw difficulty. Incorporating an Elo component introduces a continuously updated measure of skill and allows the model to capture the impact and changes.

Limitations of the Model

Several limitations must be addressed. The current weights (*e.g.*, 30% IJF points, 25% recent form, *etc.*) are heuristically assigned and may not reflect true importance. Relying only on ranking points could undervalue athletes who are improving rapidly, while the exposure metric may not generalize across weight classes or genders. The model is linear and cannot capture interactions among variables. To improve accuracy and fairness, the weights should be calibrated on historical match data using logistic regression or machine learning. Cross validation can prevent overfitting, and scoring rules such as the Brier score can assess calibration.

Working examples

Example 1 – High-Ranked Athlete, Moderate Competition

Inputs: IJF=1.00, Form=1.00, Match=1.00, Exposure=0.50, Elo=0.80.

- Simple Draw (favourable bracket: bye + below-average early opponent): Draw = 0.90 Predicted Win % = 0.920 (92.0%)
- Path-based Draw: Σ OpponentStrength = 1.30, MaxPossiblePathStrength = 3.50 Draw = $1 - (1.30 / 3.50) = 0.63$
→ Predicted Win % = 0.893 (89.3%)

Example 2 – Lower-Ranked Athlete, High Competition Exposure

Inputs: IJF=0.50, Form=0.80, Match=0.50, Exposure=0.00, Elo=0.45.

- Simple Draw (tough first round vs elite opponent): Draw = 0.25 Predicted Win % = 0.480 (48.0%)
- Path-based Draw: Σ OpponentStrength = 2.80, MaxPossiblePathStrength = 3.50 Draw = $1 - (2.80 / 3.50) = 0.20$
→ Predicted Win % = 0.475 (47.5%)

Practical Applications and Benefits of the Judo Winner Prediction Model

- Identifies expectations
- Helps with building a confidence with realistic goal-setting and strategic plans
- Optimises competition scheduling (for example: while collecting a ranking points for the Olympics)
- Informs fair and objective selection decisions
- Allows funding and support where medal potential is highest
- Creates transparent, holistic in-house rankings

Pairwise Win Probability Calculation in the Judo Winner Prediction Model

Beyond forecasting winners or overall performance, the Judo Winner Prediction Model can be applied to estimate the probability that one specific athlete will defeat another in a head-to-head contest. This is achieved by comparing the composite KPI scores of both athletes.

The pairwise method provides a straightforward way to translate KPI scores into head-to-head probabilities.

Table 2. Athlete Profiles

KPI's	Athlete A – High-ranked,	
moderate competition schedule	Athlete B – Lower-ranked,	

high competition exposure		
IJF	1.00	0.50
Form	1.00	0.80
Match Points	1.00	0.50
Exposure	0.50 (2 competitions in last	
6 months, max=4)	0.00 (4 competitions in last	
6 months, max=4)		
Elo	0.80	0.45
Draw	0.90 (favourable)	0.25 (tough)
Predicted standalone win		
%	92.5%	40%

Calculates weighted score for each athlete: $\text{Score} = 0.30 \cdot \text{IJF} + 0.25 \cdot \text{Form} + 0.15 \cdot \text{Match} + 0.10 \cdot \text{Exposure} + 0.10 \cdot \text{Elo} + 0.10 \cdot \text{Draw}$

Athlete A – predicted standalone win: 92.5%

Athlete B- predicted standalone win: 40%

The win probability between Athlete A and Athlete B is then:

$$P(A \text{ wins}) = \text{Score}_A / (\text{Score}_A + \text{Score}_B)$$

$$P(B \text{ wins}) = 1 - P(A \text{ wins})$$

$$P(A \text{ wins}) = 0.920 / (0.920 + 0.495) = 0.651 \text{ which is } 65.1\%$$

$$P(B \text{ wins}) = 1 - 0.651 = 0.349 \text{ which is } 34.9\%$$

CONCLUSIONS

The proposed judo winner prediction model demonstrates that accurate forecasts require integrating multiple dimensions of performance rather than relying solely on long-term ranking. By combining historical IJF points with recent form, opponent strength, strategic competition exposure, dynamic Elo ratings and draw difficulty, the model captures both enduring quality and short-term momentum. For the model to be truly reliable, however, heuristic weights should be replaced by data-driven ones: methods such as cross-validated logistic regression and proper scoring rules like the Brier score can assess and calibrate predictive probabilities. Hence, more studies are necessary.

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