

Inter-rater reliability of a classification system for athletes with intellectual disabilities in adapted judo competitions

Authors' Contribution:

- A Study Design
- B Data Collection
- C Statistical Analysis
- D Manuscript Preparation
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Abstract

Background and Study Aim:

The proliferation of adapted judo programs for people with intellectual disabilities has garnered continuous growth in the number of participants in this activity. As a result of this growing popularity, a number of adapted international judo competitions are now being held. The adaptive judo classification system was established to ensure that Special Needs judo athletes could be appropriately divided into categories to ensure their safety within the context of competition. The purpose of this study is knowledge about the reliability of the recently developed classification system for individuals with intellectual disabilities in adapted judo competitions.

Material and Methods:

The classification system has five levels according to functional criteria. Six raters (experts) evaluated 20 videos of official adapted judo competitions, corresponding to one of the five proposed classification categories. Two methods were used to quantify the degree of inter-rater agreement as to the analysis and classification of the recorded matches. Inter-rater agreement was evaluated using the Intraclass Correlation Coefficient (ICC) and Fleiss-Kappa procedures.

Results:

Results indicated an excellent degree of inter-rater reliability, showing that the system produces consistent results with different raters.

Conclusions:

This study represents an important step forward in the classification level of participants in adapted judo competitions for people with intellectual disabilities. Future international adapted judo competitions for people would benefit from further field studies to confirm the reliability of this classification system.

Keywords:

autism spectrum disorder • down syndrome • Paralympian • special needs judoka • Special Olympics World Games

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Conflict of interest:

Authors have declared that no competing interest exists

Ethical approval:

The study was approved by the Research Ethics Committee of the (Blinded for review), under reference number (Blinded for review). All the research protocols used in this study are in compliance with the requirements set out in the 1975 Helsinki declaration and the subsequent revisions of this document

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Intellectual disability – psychological or mental state limiting the various forms of activity performed by an individual.

ASD – autism spectrum disorder is a neurodevelopmental disorder characterized by a variety of symptoms that impact social and behavioural functioning.

Stereotypic behaviour – repetitive, invariant behaviour pattern with no obvious goal or function.

Adapted judo – judo practice that includes modifications of the objectives, methods and contents of teaching judo to children with disabilities.

Kata – prescribed patterns or sequences of techniques [34].

Paralympian – noun an athlete who competes in the Paralympics [35].

INTRODUCTION

The positive effects of physical and athletic activity on the overall health of young people with intellectual disabilities (ID) have been well documented [1]. In broad terms, the positive effects can be grouped into two areas. Firstly, there are benefits for physical health, including improvements in physical aptitudes and bone metabolism, an increase in the performance of cardiovascular and respiratory muscles, and decreases in the likelihood of obesity and a sedentary lifestyle. Secondly, there are psychosocial effects, which can include greater functional independence and fuller inclusion in social activities, as well as cognitive benefits and increases in various aspects of psychological wellbeing (especially in terms of self-esteem, self-competence and positive self-perception) [2]. Despite this evidence, a number of studies nonetheless show that people with mental disabilities tend to spend much less time than others on physical activity [3], and that these individuals tend to be in worse physical health than the population on average [4] and are more likely to be obese [5]. For these reasons, it is highly desirable to develop and implement exercise or sports programs and other educational strategies to help people with ID to improve their overall health and to motivate them to take part in regular physical activity.

Recent research involving sports, such as soccer [6], tennis [7] and baseball [8], highlight adapted sport and exercise programs developed with the aim of helping individuals with ID improve their quality of life. Meanwhile, a number of systematic reviews and meta-analyses have measured the positive effects that physical exercise and participation in sports programs including swimming, track and team sports can have for this population [2, 8-10]. In terms of the type of ID, these studies predominantly focus on individuals with down syndrome (DS) or autism spectrum disorder (ASD), while a lesser number of researchers have also examined individuals with Prader-Willi Syndrome [1].

Several studies have also provided evidence of the benefits offered by participation in martial arts programs that are adapted to meet the needs of individuals with ID [11]. Research has shown these programs to be especially effective at improving the motor skills of people with ASD [12, 13] and DS [14]. These activities have also proven to have psychosocial benefits, with karate katas aimed at people with ASD, for example, having been shown to lead to significant improvements in stereotypical behaviours and social interaction [15, 16]. The characteristics of martial arts make them well suited to the individuals with ID because of their use of moderate to vigorous exercise intensities and the added mental components of concentration and self-control [17]. Martial arts can also be appealing to young people with ASD because of the repetitive nature of the exercises involved [18]. Recent research into the effects of judo participation on children with ASD has yielded promising initial results, particularly psychosocial benefits, such as increases in both social skills and self-esteem [19]. Participants have also tended to engage in moderate to strenuous physical activity more often and to reduce the time they spend on sedentary behaviour [17].

The proliferation of adapted judo programs for people with ID has garnered continuous growth in the number of participants in this activity. As a result of this growing popularity, a number of adapted judo competitions are now being held. Institutions such as the Special Needs Judo Union (SNJU) and the Special Olympics have led the way in organizing a growing number of competitive opportunities for individuals with ID.

The rules governing these events have evolved and improved over time, with organizers striving to guarantee the safety of all the athletes who take part. In 2018, the revised rulebook was released after two years of testing. This update was developed by international experts in adaptive judo in conjunction with experienced adaptive judo referees and coaches from various countries across Europe. In the past two years (2018-2020), these

rules were used in all major national and international adaptive judo tournaments, including the Special Olympics World Games.

The regulations are now applied by adapted judo associations in 28 different countries [20] and 46 Special Olympic countries & territories worldwide [21].

With the aim of establishing worldwide standards for adapted judo events, the same rule set of the SNJU rules [20] have been adopted by Special Olympic International in their 2020 updates [21]. The rules currently in place classify participants into five categories based on their skill level. This is distinct from the mainstream classification system, which places participants according to their age and weight class. The technical rules and the scoring system used in the adapted competitions are very similar to those of the International Judo Federation, with some minor adaptations aimed at further ensuring the participants' safety.

The purpose of this study is knowledge about the reliability of the recently developed classification system for individuals with intellectual disabilities in adapted judo competitions.

MATERIAL AND METHODS

Methodology

This study consisted of two methodological phases. The first took the form of an application of the Delphi technique [22] in order to assess the validity of the proposed classification system. Six experienced experts offered their evaluation as to the classification of athletes with ID in adapted judo competitions. The resulting classifications were applied at different competitions, and the experts used the feedback obtained from the events to inform a series of changes to their criteria. They repeated this process until they had come to a consensus. The second phase consisted of an inter-rater reliability test aimed at measuring the degree of agreement between observers applying the consensus classification system. To accomplish this, the raters viewed a number of video recordings of judo bouts from adapted judo competitions.

Participants

Six raters (five men and one woman) took part in the classification process. Each of them had at least four years of experience working with

judo athletes with ID. Three of the raters were internationally certified referees with experience classifying tournament participants, and the other three were adapted judo coaches who had taken part in international competitions. The raters watched 20 videos of official adapted judo competitions, with each recorded match corresponding to one of the five proposed classification categories.

Classification protocol and assignment to categories

The adaptive judo classification system was established to ensure that special needs judo athletes could be appropriately divided into categories to ensure their safety within the context of competition. The classification system has five levels 1 to 5, with 1 representing the highest ability level and 5 indicating the lowest ability level.

The levels are determined according to functional criteria. The raters compare the skill level of the special needs judoka with that of typically-developed competitive judoka (for level 1) or that of typically-developed recreational judoka (levels 2-5). The SNJU classification system for adapted judo tournaments [20] is presented in Table 1.

Data collection procedure

All of the judo matches were video recorded from the same angle in order to ensure that the participants' movements were clearly visible. The length of each recording was limited to the beginning of the first minute in order to force the raters to issue a judgement under conditions even more demanding than they would likely face in real life.

Prior to the data collection process, the expert raters reviewed the SNJU classification criteria (2018) that have been adopted by the Special Olympics (2020). A multiple choice, video-based Moodle system (with users able to choose from five options) was developed to allow the raters to watch the adapted judo match recordings and provide an assessment of the corresponding level of the judoka. Twenty videos in total were presented, showing matches at varying levels (from 1 to 5) (level 1: $n = 3$, level 2: $n = 2$, level 3: $n = 7$, level 4: $n = 5$, level 5: $n = 3$).

Statistical analysis

Two methods were used to quantify the degree of inter-rater agreement as to the analysis and classification of the recorded matches. Inter-rater agreement was evaluated using the intraclass

Table 1. Classification system proposed for Special Needs Judo Union (2018) and adopted for Special Olympics (2020).

Level 1 is a judoka who can perform in a contest with a typical developed competitive judoka. This judoka is fast and powerful and has an excellent reactivity. He/she has a strong feeling for Judo and an excellent strategic view. This type of judoka has a minimal disability and therefore usually attends regular education. In general, these are judoka with high functioning autism or light physical disability, as well as hearing impaired judokas and some judoka with ID that have progressed beyond level 2.

Level 2 is a judoka who can perform randori with typical developed recreational judoka. This judoka is fast and powerful and has moderate reactivity but is usually slow to respond to judo situations. He/she has good judo feeling, but usually no effective strategy.

Level 3 is a judoka who can perform a playful randori with typical developed recreational judoka. This judoka is reasonably fast and powerful and has reasonably developed reactivity, but is almost always slow responding to situational judo. Strategy for this type of judoka consists of repeating the same technique over and over.

Level 4 is a judoka who can grapple and play with another judoka of the same or comparable level. Reactivity is suboptimal. Usually the only judo technique consists of takedown and immobilize.

Level 5 is a judoka who can grapple and play with other judoka of the same level. These judokas are very passive, or respond very slowly. Constant coaching to take action is necessary. When they end up in osae-komi, the action to escape can take a very long time.

Table 2. Classification level assessments of the recorded judo matches by each rater.

Match	Rater						Level allocation
	1	2	3	4	5	6	
1	4	4	5	4	4	4	4
2	4	5	4	5	4	5	5
3	4	4	4	4	4	4	4
4	2	3	3	3	3	3	3
5	1	2	1	1	1	1	1
6	1	2	2	2	2	2	2
7	5	5	4	5	5	5	5
8	1	1	1	1	1	1	1
9	3	3	3	3	3	3	3
10	3	3	3	3	3	3	3
11	5	5	5	5	5	5	5
12	4	3	4	3	4	4	4
13	4	4	4	4	4	4	4
14	3	2	3	3	3	3	3
15	2	2	2	1	1	1	1
16	4	3	3	4	4	4	4
17	2	2	2	2	2	2	2
18	3	3	2	2	3	3	3
19	3	3	3	3	3	3	3
20	2	3	3	3	3	3	3

correlation coefficient (ICC) and Fleiss-Kappa procedures. The ICC (model 2, 1) was interpreted such that >0.8 = excellent, $0.7-0.8$ = good, $0.5-0.7$ = fair, <0.5 = poor [23]. The standard error of measurement (SEM) was calculated as $SEM = SD \times \sqrt{(1-ICC)}$ [24]. Following Landis and Koch [25], Fleiss Kappa was interpreted such that a Kappa value <0.0 = poor agreement, $0.0-0.2$ = slight agreement, $0.2-0.4$ = fair agreement, $0.4-0.6$ = moderate agreement, $0.6-0.8$ = substantial agreement, and $0.8-1$ = near perfect agreement. Confidence intervals (CI) of 95% are reported with the ICC and Fleiss Kappa values. Statistical analyses were performed using SPSS software v.24 (SPSS Inc., Chicago, IL, USA).

RESULTS

The six raters displayed excellent agreement in their level assessments of the recorded judo matches with an ICC value of 0.91, (CI of 95%, 0.84 to 0.95, $p < 0.001$) and SEM of 0.36. Table 2 shows the raters' classifications for each of the bouts.

The Fleiss Kappa values for classification level assessments within raters reflected agreement between substantial and nearly perfect, with a mean percentage of agreement of 85% (Table 3).

The Fleiss Kappa values for classification level assessments indicated at least substantial agreement (with the proportions of agreement reaching at least 77.77%) (Table 4), with the exception of the level 2 judo matches.

DISCUSSION

The high level of agreement between the raters is reflected in the ICC calculation, which yielded a figure of 0.91. This indicates an excellent degree of inter-rater reliability, showing that the system produces consistent results with different raters. The fact that the levels of inter-rater reliability found in this study were so high is especially significant given that the video recordings used were only one-minute long. This limited opportunity for observation might have been an obstacle to the classification, and such a limitation would not be an issue under normal circumstances. However, the fact that the raters were able to observe judo matches meant that they could analyse two participants at once. This provided them with additional context to inform their classification level assessments.

The Fleiss Kappa values indicated that the agreement among all the raters ranged from substantial to nearly perfect, with an average value of

Table 3. Intra-rater and overall agreement values.

Statistic indicator	Rater						Overall
	1	2	3	4	5	6	
Fleiss Kappa (95% CI)	0.67 (0.41-1.03)	0.67 (0.43-1.05)	0.60 (0.39-0.97)	0.87 (0.54-1.20)	0.93 (0.52-1.08)	1 (0.76-1.24)	0.79 (0.52-1.22)
% agreement	80%	75%	70%	90%	95%	100%	85%

Table 4. Classification level and overall assessment agreement values.

Statistic indicator	Level					Overall
	1	2	3	4	5	
Fleiss Kappa (95% CI)	0.71 (0.59-0.82)	0.49 (0.38-0.60)	0.71 (0.59-0.82)	0.68 (0.56-0.79)	0.71 (0.59-0.82)	0.66 (0.60-0.72)
% agreement	77.77%	91.66%	90.47%	83.33%	83.33%	85%

0.79. One possible explanation for the high level of inter-rater reliability found here is the fact that this classification system has already been in use for a few years in unofficial competitions and exhibition matches. In other words, the referees and coaches who are responsible for applying these standards are already familiar with them. Earlier studies [26] have found that the inter-rater reliability of tests measuring athletes' functional skills tends to increase when the raters have more training and experience. Our study further confirms this, as the raters who displayed the greatest degree of agreement were those with the most experience and those who were certified referees. The latter are responsible for classifying athletes prior to competitions. In light of this, it is clear that future raters should be given practical training in order to ensure they have the experience they need.

A number of prior studies have examined the validity and reliability of a range of different classification methods for athletes in adapted sports [27-31]. The level of agreement reflected in this study by the Fleiss Kappa values for the assignment to classification levels was not as high as it was for the raters, but it was nonetheless considerable. All the classification levels showed a substantial degree of agreement (0.6-0.8) with the exception of level 2, where the figure was 0.49, indicating only moderate agreement. However, this was the category that showed the highest percentage of overall agreement (91.66%). This discrepancy between the low Fleiss Kappa value and the high overall agreement is likely due to the fact that this category was the least represented in the sample (only two bouts). A study by Rosén et al. [31] on the reliability of a classification system for Paralympian in a sport called *Para Va'a* reached a similar conclusion. This study found that tests with a lesser prevalence of cases yielded lower values, thus providing evidence that Fleiss Kappa statistics are affected by the number of cases in each category [32].

As indicated above, adapted judo athletes are placed into five classification levels based on the assessment of raters. The results of this study can be approached as nominal variables in that each level corresponds with an independent category, but they can also be taken as ordinal, in that each level represents a progression with respect to development of specific judo skills. The method used here to assess inter-rater reliability is a way to quantify the degree of agreement among a group of raters who independently analyze and score a group of participants [33]. More specifically, this study has

used both ICC and the Fleiss-Kappa calculations, in order to establish the level of agreement between the raters and to analyze the data collected. The fact that the ICC calculations yielded higher values than the Fleiss-Kappa can be explained by the kind of data used in this study. The Fleiss-Kappa test is better suited to use with nominal variables such as data collected using a Likert scale, while the ICC is more effective with ordinal data [33]. Therefore, it is possible to conclude that the ICC test is the best fit when it comes to making inferences about the agreement between raters, while the Fleiss Kappa also allows us to analyse the agreement attained within each classification level.

CONCLUSIONS

This study represents an important step forward in the classification level of participants in adapted judo competitions for people with ID. The study found high levels of inter-rater reliability using different agreement analysis methods of scores assigned to video recorded matches by expert raters. Future international adapted judo competitions for people would benefit from further field studies to confirm the reliability of this classification system.

HIGHLIGHTS

The safety of participants in sports competitions for people with intellectual disabilities is essential. This study confirms that the classification system for people with intellectual disabilities in judo competitions that is currently being used is valid and reliable.

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