Classification system for ineligible impairments in Paracanoe

Ana Larma, Selma Palacín, Ismael Uali, David Rivera, Higinio Rivero

Real Federación Española de Piragüismo.

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Summary

Introduction: The International Paralympic Committee (IPC) has stressed the importance of sport-specific classification systems to manage the impact of impairment on competition outcomes.
In Paracanoe (canoeing) there are three deficiencies that are considered eligible for the International Canoe Federation (ICF) and that determine six sport classes, three in Kayak "KL1-KL2-KL3" and three in Va'a "VL1-VL2-VL3".
Material and method: Based on the technical model of paleo in conventional athletes, muscle balances are performed in all ranges of motion, goniometry and specific balance tests in the lower and upper limbs and trunk for paracanoe practitioners (paracanoes) who present ICF ineligible deficiencies. Muscle strength is scored from 0 to 2, as determined by the ICF classification model, and the points are grouped into a cluster.
The ICF (Special) ineligible impairment classification system groups into eight sporting classes according to the score obtained called "KS1-KS2-KS3-KS4-VS1-VS2-VS3-VS4".
Results: Data were collected from 346 athletes: 107 had impairments eligible for the ICF and 239 had impairments not eligible in the international system. By means of a specific assessment of muscle strength in athletes with ineligible impairments, these athletes were grouped into eight competition classes.
Conclusions: Evaluating non-eligible deficiencies with a specific classification system allows for the separation of Special sports classes, taking into account the functional impact that each of them has on paracanoeing.
Discussion: By carrying out specific tests on Paracanoe athletes with ineligible disabilities, data can be collected on the impact that each impairment has on this sport.

Key words:
Paralympic classification. Eligible impairment. Sport classes.

Sistema de clasificación en deficiencias no elegibles en paracanoe

Resumen

Introducción: El Comité Paralímpico Internacional (IPC) ha resaltado la importancia de los sistemas de clasificación específicos para cada deporte, para controlar el impacto de la deficiencia en el resultado de la competición.
En paracanoe (piragüismo) hay tres deficiencias que se consideran elegibles para la *International Canoe Federation* (ICF) y que determinan seis clases deportivas, tres en Kayak "KL1-KL2-KL3" y tres en Va'a "VL1-VL2-VL3".
Material y método: A partir del modelo técnico de paleo en deportistas convencionales, se realizan balances musculares en todos los rangos de movimiento, goniometrías y pruebas específicas de equilibrio en miembro inferior, superior y tronco a los practicantes de paracanoe (paracanoes) que presentan deficiencias no elegibles ICF. Se puntúa la fuerza muscular de 0 a 2, como viene determinado en el modelo de clasificación ICF, y se agrupan los puntos en un clúster.
El sistema de clasificación para las deficiencias no elegible ICF (*Special*) agrupa en ocho clases deportivas según la puntuación obtenida denominadas "KS1-KS2-KS3-KS4-VS1-VS2-VS3-VS4".
Resultados: Se han recogido datos de 346 deportistas: 107 presentaban deficiencias elegibles para la ICF y 239 deficiencias no elegibles en el sistema internacional. Mediante la valoración específica de la fuerza muscular en los deportistas con deficiencias no elegibles, se ha agrupado a estos deportistas en ocho clases de competición.
Conclusiones: Evaluar con un sistema específico de clasificación a las deficiencias no elegibles permite separar las clases deportivas *Special*, teniendo en cuenta la afectación funcional que tiene cada una de ellas en el paracanoe.
Discusión: Mediante la realización de pruebas específicas en deportistas paracanoe con deficiencias no elegibles se pueden recoger datos del impacto que tiene cada afectación en este deporte.

Palabras clave:
Clasificación paralímpica. Deficiencia elegible. Clases deportivas.

Correspondence: Ana Larma
E-mail: analarma@gmail.com

Introduction

The International Paralympic Committee has defined sports classification as "the process of grouping athletes into sports classes, according to the degree to which the disability affects them in carrying out the specific activities to each sport or discipline"[1].

Each sport has its own classification system, which also determines the type of disability eligible for each sport[2].

Spanish sports federations must include in their classification systems the eligible impairments that are included in the corresponding international federation. In addition, they may include other eligible impairments that are included in the Paralympic classification code, in order to promote the participation of people with disabilities, as well as the development of the sporting modality or discipline[3].

The eligible impairments for Paralympic sports according to the international standard[4] are as follows:

– *Deficiency in muscle power:* Athletes who have a deficiency in muscle power have a health condition that reduces or eliminates their ability to voluntarily contract their muscles in order to move or generate force.
  Examples of conditions that may result in impaired muscle power include: spinal cord injury (complete or incomplete, tetraplegia or paraplegia), muscular dystrophy, post-polio syndrome, and spina bifida.
– *Passive range of motion impairment:* Athletes with range of motion impairments have a condition that reduces or eliminates motion in one or more joints. Conditions that may lead to passive range of motion impairment include arthrogryposis and contracture resulting from chronic joint immobilization or trauma to a joint.
– *Limb deficiency:* Athletes with limb deficiency have a complete or partial absence of bones or joints as a result of trauma (traumatic amputation), disease (bone cancer), or congenital limb deficiency (dysmelia).
– *Leg length discrepancy:* Athletes who have a leg length discrepancy as a result of limb growth disturbance or as a result of trauma.
– *Short stature:* Athletes with short stature have a reduction in the length of the bones of the upper and lower limbs and/or trunk. Examples of health conditions that can lead to short stature include: achondroplasia, growth hormone dysfunction, and osteogenesis imperfecta.
– *Hypertonia:* Athletes with hypertonia have increased muscle tension and reduced ability to stretch muscles caused by damage to the central nervous system. Examples of health conditions that can lead to hypertonia include: cerebral palsy, traumatic brain injury, and stroke.
– *Ataxia:* Athletes with ataxia have uncoordinated movements caused by damage to the central nervous system. Examples of medical conditions that can lead to ataxia include cerebral palsy, traumatic brain injury, stroke, and multiple sclerosis.
– *Athetosis:* Athletes with athetosis continually have slow, involuntary movements. Examples of medical conditions that can lead to athetosis include cerebral palsy, traumatic brain injury, and stroke.
– *Visual impairment:* Athletes with visual impairment have reduced or no vision as a result of injury to the eye structure, optic nerves or pathways, or the visual cortex of the brain. Examples of medical conditions that can lead to visual impairment include retinitis pigmentosa and diabetic retinopathy.
– *Intellectual Disability:* Athletes with intellectual disability have a limitation in intellectual functioning and adaptive behavior, as expressed in conceptual, social, and practical adaptive skills. This disability must be present before the age of 18.

The classification system developed by the International Canoe Federation (ICF) has included in its classification manual three eligible impairments[5] to compete in paracanoe:

– Deficiency of muscle power in the lower limbs and trunk.
– Lower limb deficiency.
– Deficiency of passive range of motion in lower limbs.

The rest of the eligible impairments are considered ineligible to compete in paracanoe, including those with upper limb disorders, ataxia, hypertonia, visual deficiency, among others, who are eligible for other Paralympic sports such as, for example, adapted rowing.

The inclusion of all eligible deficiencies Paralympic Committe in one classification system aims to:

– To include upper limbs in the paracanoe classification system. They are currently excluded as an eligible deficiency, which only includes the absence of lower limbs.
– To promote the paracanoe modality for all eligible deficiencies and for all people with some type of disability.
– To collect muscle balance and goniometry data on the classification tables for all eligible impairments.
– To group into the same competition class athletes who have different EI but have the same score.

The Spanish Paralympic classification code specifies that different impairments can be grouped into the same sports classes, provided they have the same affectation[6].

In the international classification regulations, it is determined that Paralympic sports are reserved for athletes with eligible disabilities[7] (Table 1).

Material and method

The Spanish Paralympic Committee has defined the classification table as the evaluation that must be carried out jointly by the functional classifiers (doctor/physiotherapist) and the technical classifiers.

An athlete's classification table must follow four steps:

– Check if there is an eligible disability that impacts the sport.
– Evaluate whether that deficiency meets a minimum criterion to be considered eligible.
– Grant the sports class according to the limitation in the athlete's activity.
– Determine whether the classification status should be reviewed or can be considered permanent.

346 classification tables were carried out on Paracanoe athletes. Of these, 107 had eligible impairments and were classified according to the international classification model established by the ICF. 239 had impairments that were not eligible to be classified using the ICF model, and were tested to determine their functionality and whether the impairment they presented had an impact on Paracanoe.

The classification procedure for ineligible deficiencies in Paracanoe includes specific examinations for the lower and upper limbs, trunk, balance tests and evaluation of the paddling technique in water during the National Classification Tables.

In Paracanoe there are two different sports depending on the type of boat used, as well as the paddling technique used in each one. They are called Kayak and Va'a (Figure 1).

The sporting class for athletes with ineligible disabilities will be called Special in this classification system, for kayak Special (KS) (Figure 2) and Va'a Special (VS).

Figure 1. Kayak and Va´a Model.

Figure 2. Ergometer measurement protocol

Special kayak classification methodology

– The biomechanical posture of the athletes on a kayak ergometer is taken as a reference. Goniometries are taken in the effective ranges of mobility in canoeing in the lower and upper limbs and trunk. The impairments that will be considered are those listed by the WHO in its international classification manual[9].
– Muscle balances are performed on all muscle groups involved in the paddling technique in lower and upper limbs and trunk and are scored from 0-2 following a model similar to that used in the international classification system. Muscle incoordination is added as an element that reduces the paddler's functional capacity.
  - 0: complete absence of movement or minimal contraction of the muscle, but no movement in the muscle itself.
  - 1: minimal contraction that cannot be performed against resistance and cannot be performed with the force of gravity as resistance. Uncoordinated muscle movements due to the impact of pathology such as ataxia or cerebral palsy.
  - 2: full contractions with moderate or maximum resistance.
– Specific coordination and balance tests are performed on trunk, lower and upper limbs. These tests are used to detect severe balance and coordination disorders that may occur in athletes with eligible deficiencies such as ataxia or athetosis.
– The following tests are performed in water:
  - Test 1: from buoy 1 the athlete makes a maximum start and rows at maximum speed to buoy 2.
  - Test 2: from buoy 2 the athlete makes a maximum start and rows at maximum speed to buoy 1.
  - Test 3: from the left side of the dock, the athlete makes a maximum start and rows at maximum speed to buoy 3.
  - Test 4: from the right side of the dock the athlete makes a maximum start and rows at maximum speed to buoy 4.
  - Test 5: from the end of the dock the athlete makes a maximum start and rows at maximum speed to buoy 5.

Table 1. Eligible impairments in Paralympic sports

	Physical disability 1. Hypertonia 2. Athetosis 3. Ataxia 4. Impaired Muscle Power 5. Impaired Passive Range of Movement 6. Limb Deficiency 7. Leg Length Difference 8. Short Stature								9 Intellectual Impairment	10 Visual Impairment
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Athletics	I	I	I	I	I	I	I	I	I	I
Badminton	I	I	I	I	I	I	I	I		
WC Basketball	I	I	I	I	I	I	I			
Boccia	I	I	I	I	I	I				
Cycling	I	I	I	I	I	I	I			I
WC Fencing	I	I	I	I	I	I	I			
5-a-side football										I
Goalball										I
Equestrian	I	I	I	I	I	I	I	I	N	I
Judo										I
Swimming	I	I	I	I	I	I	I	I	I	I
Canoeing	N	N	N	I	I	I	N	N	N	N
Powerlifting	I	I	I	I	I	I	I	I		
Rowing	I	I	I	I	I	I				I
WC Rugby	I	I	I	I	I	I				
Taekwondo	I	I	I	I	I	I	N	N	N	N
Table tennis	I	I	I	I	I	I	I	I	I	
WC Tennis	I	I	I	I	I	I	I	I		
Shooting	I	I	I	I	I	I				N
Archery	I	I	I	I	I	I	I		N	N
Triathlon	I	I	I	I	I	I	I	N	N	I
Volleyball	I	I	I	I	I	I	I			
WC Curling	I	I	I	I	I	I				
Alpine skiing	I	I	I	I	I	I	I			I
Nordic skiing	I	I	I	I	I	I	I			I
Biathlon	I	I	I	I	I	I	I			I
Ice hockey	I	I	I	I	I	I	I			
Snowboarding	I	I	I	I	I	I	I			

- I Internationally eligible impairments
- N Additional nationally eligible impairments

  - Test 6: from buoy 5 the athlete makes a maximum start and rows at maximum speed to the dock.
- The scores obtained in all the muscle balances are grouped into clusters.
- A classification itinerary is established by adding the clusters in all the tests carried out, so that in the same competitive class all athletes have the same score, regardless of the eligible deficiency they present (Table 2).

Special Va'a classification methodology

- The biomechanical posture of athletes on the Va'a ergometer is taken as a reference. Goniometries are taken in the effective ranges of mobility in canoeing in the lower and upper limbs and trunk.
- Muscle balances are performed on all muscle groups involved in the paddling technique in lower and upper limbs and trunk and are scored from 0-2 following a model similar to that used in the international classification system. Muscle incoordination is added as an element that reduces the paddler's functional capacity.
  - 0: complete absence of movement or minimal contraction of the muscle, but no movement in the muscle itself.
  - 1: minimal contraction that cannot be performed against resistance and cannot be performed with the force of gravity as resistance. Uncoordinated muscle movements due to the impact of a pathology such as ataxia or cerebral palsy.

Table 2. Itinerary classification K Special.

	Clúster	Clúster	Clúster	Clúster	Clúster
Upper limbs	1	1/2	2		3
Upper limb balance	1	1/2	2		3
Lower limb	1/2	1/2	Kl	2/3	3
Lower limb balance	1/2	1/2	Kl	2/3	3
Trunk	1/2	1/2	Kl	2/3	3
Points	6/9	10/15	10/15	16/17	18
Classification	KS.1	KS.2	KS.2	KS.3	KS.4

- 2: full contractions with moderate or maximum resistance.

– Specific coordination and balance tests are performed on trunk, lower and upper limbs. These tests are used to detect severe balance and coordination disorders that may occur in athletes with eligible deficiencies such as ataxia or athetosis.
– Maneuvers are carried out with the boat to determine whether the damage has an impact on the sport in a specific way.
– The scores obtained in all muscle balances are grouped into clusters. In the Va'a Special classification, a system of point correction is established to equalize the affectation of the lower and upper limbs, trunk, balance and water, just as it is done in the classification model of the international ICF system, and the Va'a Special classification itinerary is established (Table 3).

Results

There are currently 346 athletes in Spain who have completed the classification table; of these, 107 had eligible deficiencies for the ICF (KL) and 239 had not eligible deficiencies for the ICF (Special) (Table 4).

Athletes with eligible disabilities (KL) are grouped into six competition classes: three in kayak KL1, KL2, KL3 and three in Va'a VL1, VL2 and VL3.

– KL1-VL1: athletes without or with very limited function in trunk. No function in lower limbs
– KL2-VL2: athletes with limited function in lower limbs, with involvement of trunk. They may require high-back seats.
– KL3-VL3: athletes with full trunk function and partial leg function.

The ICF international classification model groups the Kls into clusters and the VLs are grouped into clusters by weighing the tests with a factor, so that all the evaluations have the same impact on the classification[10]. The Special classification system has followed the same classification mode for Ks and Vs. Therefore, the eight classification classes have been grouped with the following model:

– KS1: athletes with functional impairment whose pathology directly affects the execution of the technical gesture, including the upper limb, balance impairment, and who have a score of 6-9 in the cluster.
– VS1: athletes with severe upper limb involvement and/or trunk involvement, and/or lower limb involvement. With less than 175 points out of a maximum of 264.
– KS2: athletes with functional impairment in upper limbs, upper limb balance, loss of points in specific water tests and whose pathology directly affects the execution of the technical gesture. With a score of 10-15 in the cluster.
– VS2: athletes with moderate involvement of the upper limbs and who also have some involvement of the lower limbs and/or trunk. Moderate/evident involvement of the upper limbs. With a score of 176-219 points out of a maximum of 264.

Table 3. Eligibility criteria and Va’a Special itinerary.

	Eligibility criteria Va ´a Special	
Process and function evaluation	• Batteries of tests are carried out for the upper limb, trunk, balance, lower limb and water. • The maximum score that can be obtained in a test is 44, which corresponds to the maximum number of points that can be achieved in the MMSS tests. • The impact of MMSS is prioritized in the classification. • A table is established with the maximum score in all functional tests and the correction factor.	
Maximum points and factor applied in functional tests	• Upper extremity 44 maximum points in functional tests. Factor 1. • Balance in upper limbs 2 maximum points in functional tests. Factor 22. • Lower extremity 28 maximum points in functional tests. Factor 1.57. • Balance in lower limbs 2 maximum points in functional tests. Factor 22. • Trunk: 12 maximum points in functional tests. Factor 3.47. • Specific test in water maximum 8 points. Factor 5.5.	
Sports class	**Itinerary according to the affected function**	**Punctuation**
VS-1	• Severe involvement of upper limbs. • Affectation of the trunk or lower limbs with a diagnosis of any deficiency not eligible for ICF.	Less than 175
VS-2	• Moderate involvement in upper limbs. • Moderate involvement of the trunk or lower limbs with a diagnosis of any deficiency not eligible for ICF.	176/219
VS-3	• Paddlers with little involvement in the upper limbs. • It only affects a functional test.	220/263
VS-4	• There is no affectation in muscle or joint balance. • They present impairment of any other nature accredited by a 33% disability certificate.	264

Table 4. Percentage of sportsmen and sportswomen classified under the Special system.

CLASSES ICF	KL1	KL2	KL3	VL1	VL2	VL3	TOTAL		
Man	11	16	27	5	8	9	76		
Woman	2	4	15	0	3	7	31		
	13	20	42	5	11	16	107		
%	3,75%	5,78%	12,13%	1,44%	3,17%	4,62%	30,92%		
CLASSES RFEP	**KS1**	**KS2**	**KS3**	**VS1**	**VS2**	**VS3**	**KS4**	**VS4**	
Man	2	9	29	0	3	51	65	22	181
Woman	2	4	7	2	1	12	21	9	58
	4	13	36	2	4	63	86	31	239
%	1,15%	3,75%	10,40%	0,58%	1,15%	18,20%	24,85%	8,95%	69,07%

– KS3: athletes with minimal functional impairment in lower limbs, balance or trunk (cluster 16/17) or no impairment (cluster 18).
– VS3: athletes with little or very little involvement of upper limbs and with no or very little involvement of trunk and lower limbs. With a score of 220-263 points out of a maximum of 264.
– KS4: athletes without functional impairment, but with organic impairment, intellectual, developmental or other nature that affects the ability to perform the activity. 264 points.
– VS4: athletes without functional impairment, but with organic impairment, intellectual, developmental or other nature that affects the ability to perform the activity. 264 points.

Discussion

Sports Law 39-2022 determines that all people with disabilities must be integrated into the National Federations[11] when they are recognized in their corresponding International Federation[12].

Within the International Canoe Federation, the following are considered eligible impairments: lack of muscle power, limited range of movement and absence of lower limbs. Following the guidelines set out by the Sports Law, all athletes with disabilities have been integrated into the National Federations within the Open competition class, in which there is no differentiation of the impairment presented by each paddler. In Spain this category is called Special.

The purpose of this classification system is to group athletes who have ineligible deficiencies (Special) and who are not currently being classified by the international system based on the impairment in function.

Furthermore, the lack of prior studies on athletes with non-eligible deficiencies (Special), such as upper limb impairment, makes difficult to include them in future international competition classes.

As a result of the classification tables, in which functional tests have been carried out on all athletes, including muscle balances, goniometry, specific balance tests and assessment in water, it has been found that Special athletes present functional impairment in the execution of the technical gesture of canoeing, impairment in balance tests, coordination or other types that after carrying out the classification tables with the Special system can be grouped into sports classes.

Conclusions

The development of a classification system for Paracanoe athletes with ineligible impairments by the International Canoe Federation (ICF) allows for a wider inclusion of athletes in this discipline. The specific classification, through assessments of balance, muscle strength and coordination, organizes athletes into categories that accurately show the functional impact of their impairments, establishing a fair model that prioritizes sporting excellence over physical condition.

Therefore, after reviewing and discussing the results obtained, we can conclude that performing functional tests on all the eligible deficiencies by the International Paralympic Committee allows us to collect data based on evidences as required by the development of classification systems by the International Paralympic Committee[13] such as, for example, ranges of mobility and muscle balances, and grouping athletes into sports classes based on the score obtained in the functional tests performed.

Conflict of interest

Authors declare no conflict of interest.

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