Laurea specialistica in Scienze delle attività motorie preventive ed adattate

Monitoraggio e valutazione dell'attività motoria adattata (Disabili) - METODI E DIDATTICHE DELLE ATTIVITÀ MOTORIE (2009/2010)

Alcuni aspetti degli sport paralimpici

Mercoledì 12 Maggio h. 9÷10:30 MDAm4

Luca P. Ardigò

ones and illustrates why each is not suitable. Note that while it is common to refer to "classifying athletes", the IPC takes this opportunity to reinforce that the unit of classification in Paralympic systems should be impairments, not athletes. This distinction is important because it reinforces that each athlete is a unique, sentient human being whose diversity and individuality cannot be captured by assigning a label or a class.[4,12]

[See Table 2 at the end of the document]

Practical implications
A sound taxonomic structure is a necessary pre-requisite for the development of evidence-based systems of classification because it permits the formulation of research questions that can be addressed using conventional experimental science. Paralympic sports seeking to develop evidence-based systems of classification should revise their current systems in light of the information presented in this section. The opening sections of the IPC Athletics Classification Project for Physical Impairments; Final Report – Stage 1[10] provide a working example of how a classification manual can be taxonomically structured so as to permit the experimental research needed to develop an evidence-base.

DEVELOPING EVIDENCE-BASED SYSTEMS OF CLASSIFICATION – RESEARCH NEEDS

When systems of classification have the necessary taxonomic structure, including identification of the unit/s of classification and an unambiguous statement of purpose, the task of developing an empirically evaluating methods of classification through research can be addressed.
Fleishman and Quaintance [2] identify two types of classification research:

- Product-focused research, which evaluates the relationships between and within the formal set of classes or categories that results from classification; and
- Process-focused research which includes theoretical work establishing the taxonomic principles underpinning classification systems and empirical research which evaluates the validity of the methods used to place the units into classes.

Development of evidence-based systems of classification requires process-focused research. The remainder of this section illustrates why product-focused research has limited capacity to contribute to development of evidence-based systems of classification and expands upon the process-focused research that is required.

Product-focused research
Product-focused research is of value, but only once evidence-based systems of classification are in place. Examples of previously conducted product-focused research include evaluation of intra- and inter-classifier

reliability and inter-class performance comparisons.[13-16] Figure 4 presents a typical product-focused analysis – a performance comparison of male athletes in four wheelchair racing classes. The y-axis indicates performance (sec) for four distances – 100m, 200m, 400m and 800m; and the x-axis indicates wheelchair racing class, T51 being the most impaired and T54 being the least. While these data clearly demonstrate an inverse relationship between class and performance, they provide only weak evidence that classification in wheelchair racing is valid. This is because there are at least three possible explanations for the results, these being that athletes are classified according to:

- how much their impairment affects performance
- racing performance alone; or
- a combination of the above.

It is critical that when researchers aim to develop and validate evidence-based classification systems, they utilize research designs that validate a classification process, rather than evaluate classification product.

[See Figure 4 at the end of the document]

Process-focused research – what is required?
It has already been established that a necessary pre-requisite for the development of evidence-based systems of classification is an unambiguous statement indicating that the aim of the system is to classify eligible impairments according to the extent of activity limitation they cause. This statement of purpose provides clear direction to researchers aiming to develop evidence-based systems of classification. The initial step requires development of objective, reliable methods for measuring both of the core constructs – impairment and activity limitation:

- Measurement of impairment: To date measurement of impairment in classification has largely been non-instrumented and has depended heavily on clinical judgement, particularly in the biomechanical impairments. In some instances these may still be the most appropriate methods, however researchers should explore the use of instrumented measures which are simple, readily available which are more objective and less dependent on user judgement. Criteria for valid tests of impairment are as follows:
    - Impairment specific: The test should measure effect of only one impairment type without "contamination" from other impairment types. For example, a tapping test for coordination should require minimal range of movement, balance and strength in order to be executed. As far as possible, the test should also exclude the impact of non-eligible impairment types, such as problems with motor planning;

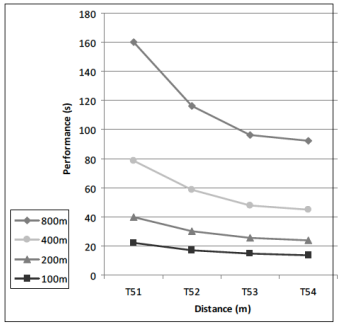
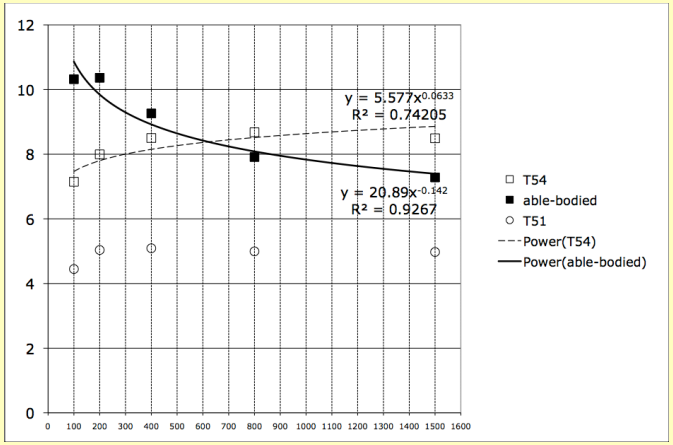


Figure 4: World record times for the four male wheelchair racing classes in Paralympic Athletics for four distances – 100m, 200m, 400m and 800m


12
10
8
6
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2
0
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600
y = 5.577x^0.0633
R² = 0.74205
y = 20.89x^-0.142
R² = 0.9267
T54
able-bodied
T51
Power(T54)
Power(able-bodied)

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- Account for greatest variance in wheelchair racing performance: Within the constraints implied by the first criterion, a given test of impairment should account the maximum possible amount of variance in performance by:
  assessing the body structures that will impact performance (e.g., elbow ROM will impact wheelchair racing; ankle ROM will not);
  - assessing in body positions relevant to sports performance (e.g., in tests of impaired coordination for wheelchair racing, participants should be tested in a seated position, and movements of the arm should be in the sagittal plane;
  - using composite measures wherever possible (e.g. instead of individually measuring strength at the wrist, elbow and shoulder, a wall-push test involving all of the relevant muscle groups would be likely to produce a measure that would account for more of the variance in wheelchair performance) ;
- Where possible the measure should be resistant to training. For example, in the sport of athletics many athletes use plyometric and power training drills to enhance performance. Therefore if strength impairment was assessed using a plyometric or power measure, it is likely that a well trained athlete would perform better than untrained athlete of comparable impairment severity, creating the possibility that the well-trained athlete would be placed in a class for athletes with less severe impairments. Isometric strength is not usually trained by athletes and evidence indicates that isometric measures do not respond to power-type training [18], making it a more suitable measure of strength impairment for the purposes of classification in Paralympic athletics.

- Measurement of activity limitation: methods for evaluating activity limitation will vary according to the sport of interest and the impairment group of interest – biomechanical impairment, vision impairment or intellectual impairment. One approach is to identify the vision, intellectual or biomechanical activities that have the greatest impact on performance in the sport of interest, and use these activities as the basis for the development of highly standardized, sport-specific activity limitation test protocols. For example, in order to push a racing wheelchair rapidly requires two biomechanically distinct activities or techniques – the technique used to accelerate from a stationary position and the technique used to maintain top speed. When athletes with eligible biomechanical impairments (e.g., impaired strength, impaired range of movement or hypertonia) perform these activities – acceleration from stationary and maintenance of top speed – to the best of their ability, then decreasing performance (measured in seconds) will directly reflect

increasing activity limitation in wheelchair racing. In order to evaluate the impact of impairment on a sports activity, researchers must ensure that all athletes perform exactly the same, highly standardised activity (i.e., same equipment, positioning etc): if athletes are permitted to adopt individualised positioning and use strapping and other aids, the activity is effectively changed to a new activity in which the impact of impairment is reduced, making comparison of results across participants impossible.

When appropriate measures have been developed, researchers can acquire measures of impairment and performance from a sample of athletes and analyse the results using appropriate multivariate statistics. The result of the multivariate analysis will be a regression equation that reflects the relative strength of association between the various measures of impairment and activity limitation. The sample of athletes upon which the regression equation is based should be racially representative and as large as practical.

Once a regression equation has been derived and verified through research, it will form the basis of classification process. Classifiers will evaluate athletes using the standardised measures of impairment validated through research, and results from each impairment measure will be entered into the relevant regression equation to obtain a single impairment score. The impairment score will have a relationship to activity limitation in the sport of interest that is based upon empirical evidence. In this way the current problems associated with weighting and aggregating measures of impairment will be addressed.

Note that the research methods described above quantify the relative impact of impairment on highly standardised activities that permit very minimal variation in terms of individualised positioning and equipment, and that classification methods that will be used in practice will be based on the relative impact of different impairments on performance of these activities. In the competitive arena, many sports permit classified athletes to use individualised positioning and techniques, as well as strapping and other aids, which effectively alter the activity that each individual does in a way that minimises the impact of an individual's impairment, thereby enhancing performance. Use of individualised adaptations should not affect the class that an athlete is allocated. However sports technical officials must be cognisant of the impact that each individualised adaption will have and ensure that technical rules governing permissible techniques and aids (including the materials that aids are made of) regulate their use so that the integrity of the sport is maintained.

Dividing impairments into classes
The task of creating classes can be addressed once the relationship between impairment and activity limitation in a given sport has been described. In some instances the data may indicate "natural" classes.[2]

Natural classes may be indicated by a single, empirically verifiable critical feature. For example, in lower limb amputees, amputation above the knee causes significantly greater activity limitation in running than amputation below the knee, indicating that athletes with a knee joint should compete in a different class to those without a knee joint. Natural classes may also be indicated where the data indicate a clear cut point in a continuous variable. Figure 3 illustrates the presence of two cut points in a hypothetical data set which plots wheelchair racing performance (y-axis) against wheelchair specific impairment (x-axis), a single, continuous score derived from a number of measures of impairment that have been weighted and aggregated according to an evidence-based regression equation. The graph indicates that decreasing impairment score is associated with improved racing performance (i.e. decreased activity limitation), however the decline is not uniform – a decrease in impairment from ten to eight is associated with a decrease in race time from 100 sec to 90 sec, however an decrease in impairment from eight to seven is associated with a decrease of 30 sec in race time. A similar drop occurs when impairment increases from five to four. These data suggest two cut points and therefore three natural classes: class one for athletes with impairment scores from ten to eight; class two for impairment scores from seven to five and class three for impairment scores from four to one.

In instances when the relationship is strictly linear and does not suggest natural classes, setting the boundaries of classes will be more challenging. Because extent of activity limitation is a continuous variable, it is mathematically impossible to create a classification system in which classes only comprise athletes experiencing exactly the same degree of activity limitation. Given that classes must always span a range of activity limitation, the most important guiding principle for setting the number of classes should be that within any given class, the range of activity limitation should never be so large that athletes with impairments causing the greatest activity limitation are significantly disadvantaged when competing against those with impairments causing the least activity limitation.[4] For example, tetraplegic and paraplegic athletes should not compete in the same wheelchair racing class because the range of activity limitation resulting from impairment in such a class would be too large. However, to ensure the competitive field for each class is as large as possible, the range of activity limitation within a class should also be as large as possible without disadvantaging those most severely impaired.
It is critical that the number of classes in a given sport is based on these objective principles. When the number of classes has been determined, it is the role of sports federations and their administrators to put in place effective promotion and retention strategies in order to maximise participation and ensure large, competitive fields in each class. If numbers in a particular class are low, this is an indication that a sport needs to employ more effective promotion and retention strategies: it is not an indication that the number of classes should be reduced. The notion that the number of classes in a given sport should be driven by the number of

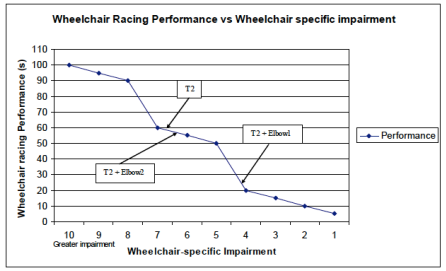

Figure 3: Illustrative graph – Wheelchair racing performance vs. wheelchair-specific impairment. T2 indicates wheelchair specific impairment caused by T2 cord injury with no other impairments; T2 + Elbow1 indicates wheelchair-specific impairment caused by T2 cord injury with elbow extension deficit causing significantly greater activity limitation than T2 injury alone; and T2 + Elbow2 indicates wheelchair-specific impairment caused by T2 injury with elbow extension deficit causing negligible increase in activity limitation.

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athletes competing in that sport at a single time point will lead to long-term instability in classification systems and runs counter to the aim of developing evidence-based systems of classification.

Other research needs
As has been identified, there is a critical need for research which will describe the extent to which impairments of varying type, severity and distribution impact on performance in the Paralympic sports. However measurement of impairment for the purposes of Paralympic classification poses at least two further significant challenges.

Identifying intentional misrepresentation of abilities
It is well recognized in order to obtain valid measures, many tests of impairment require the athlete to attempt the test to the best of their ability. Anecdotal evidence indicates that some athletes try to obtain a more favourable classification by intentionally misrepresenting their abilities (i.e., not attempting all tests to the best of their ability in order to appear to exaggerate the severity of the impairment). To deter athletes and support staff from conspiring to intentionally misrepresent abilities, the Classification Code [17] contains severe sanctions, up to and including a lifetime ban from Paralympic sport. Objective methods for identifying intentional misrepresentation of abilities would provide an important, empirical basis for enforcing sanctions, and research developing and validating such methods is required. Such methods are an important means of assuring all Paralympic stakeholders – athletes, coaches, administrators, the public and the media – that the fairness and integrity of Paralympic competition is protected by sanctions that are both severe and enforceable.

Training responsiveness of impairment measures
Although measures of impairment will be largely training resistant, they are not entirely. For example, strength impairment resulting from incomplete spinal cord injury can be influenced by behaviour: chronic disuse can compound strength loss in affected muscles, and strength can be increased through resistance training. It is vital that athletes who have positively influenced their impairment scores by training are not competitively disadvantaged by being placed into a less impaired class.

One important means of guarding against this possibility is to use modalities of impairment measurement that are not sports specific. For example, measurement of strength using an isometric modality would reflect strength impairment but would also be more resistant to sports-specific strength training than dynamic modalities of strength measurement.[18]

A further safeguard will be the development of activity limitation test batteries which can be used by classifiers to differentiate untrained from well trained athletes. These batteries should comprise the activity of

interest – for example, a 30m sprint performance for runners in athletics – as well as supplementary tests of activity limitation [19]. The standing broad jump is a good example of a supplementary test of activity limitation for running, because it: a) highlights the impact of one of the eligible impairment types for running (impaired muscle strength); b) is biomechanically distinct from the activity of interest (running), but is closely correlated with running performance[20]; and c) is inexpensive and easily administered, which would facilitate international dissemination and implementation. Valid, reliable tests of activity limitation can provide classifiers with an objective indication of an athlete's level of training which is, as far as possible, independent of the effects of impairment[19] – that is, for a given impairment level, a well-trained athlete will do better on supplementary tests of activity limitation than an untrained athlete. In this way supplementary tests of activity limitation can be used to ensure that well trained athletes are not competitively disadvantaged by Paralympic classification methods.

Glossary

The ICF: the ICF is the acronym for the International Classification of Functioning Disability and Health (ICF), published in 2001 by the World Health Organisation.[21] The ICF is an international standard for describing the functioning and disability associated with health
Health Conditions are diseases, disorders and injuries and are classified in the ICD-10[22], not the ICF. Cerebral palsy, Spina bifida and multiple sclerosis are examples of health conditions;

Body functions are the physiological functions of body systems (e.g., cardiovascular functions and sensory functions). The body functions of central concern in Paralympic sport are visual function, intellectual function and neuromusculoskeletal function (see Figure 1);

Body structures are anatomical parts of the body such as organs and limbs and their components. The body structures of central concern in Paralympic sport are those related to movement and include the motor centers of the brain and spinal cord, as well as the upper and lower limbs (see Figure 1);

Impairments are problems with body functions or body structures. A person with a contracture at the right elbow would be described as having impaired range of movement. Paralympic classification systems should specify eligibility in terms of ICF impairment types (e.g., in the sport Judo, the classification system should specify that only vision impairments are classified);

Activity: an activity is the execution of a task or action by an individual. The term activity encompasses all sports specific movement, including running, jumping, throwing, wheelchair pushing, shooting and kicking (see Figure 1);

Activity limitations are difficulties an individual may have in executing an activity. In Paralympic sport activity limitations refer to difficulty executing the sports-specific movements required for a particular sport. Running is a core activity in the sport of athletics and a person who has difficulty running is said to have an activity limitation in running.

Function and disability: In the ICF the terms "function" and "disability" are non-specific umbrella terms that refer to several components of the ICF. For example, function can refer to neurological function (e.g., nerve conduction velocity), the ability to perform an activity (e.g., ability run or jump) or functioning of a person in the community (e.g., to conduct financial affairs or access health services). To minimize ambiguity the terms functioning and disability should be avoided when describing the purpose and conceptual bases of Paralympic classification;
Handicap: The term "handicap" is not used in the ICF because of its pejorative connotations in English.

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COMPETING INTERESTS
The authors do not have any competing interests with regard to this manuscript.

'What is already known on this topic'
Competition in Paralympic sport is based on systems of classification. The recently published IPC Classification Code mandates development of evidence-based systems of classification. Development of such systems is difficult because consensus regarding what constitutes evidence-based classification do not exist and because, to date, classification in Paralympic sport has been largely atheoretical.

'What this paper adds'
This paper provides a theoretically-grounded overview the scientific principles underpinning classification, as well as an authoritative position

on what constitutes evidence-based classification and guidelines for how evidence-based systems can be developed.

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