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

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Historically the transition from medical to sports-specific, functional classification systems began in the late 1970s, but there was considerable debate surrounding the relative merits of the medical and functional approaches and consequently the transition was slow.[8] One feature of early functional systems was that they comprised less classes than the existing medical systems.[9] Event organisers favoured fewer classes because the complexity of event organisation was significantly reduced. In 1989 the bodies responsible for organising the Barcelona Paralympic Games – the IPC and the Barcelona Paralympic Organizing Committee – signed an agreement which stipulated that all Paralympic sports contested at the 1992 Barcelona Paralympic Games were to be conducted using sports-specific functional classification systems.[8] This administrative decision greatly accelerated the transition to functional classification systems.

At the time of this decision many sports had not begun to develop functional systems so, given the short time-frame and the absence of relevant scientific evidence, the classification systems that were developed were necessarily based on expert opinion. Within each of the sports, senior Paralympic classifiers from a diverse range of backgrounds – medical doctors, therapists, athletes and coaches – lead the development of functional systems of classification.

Current Paralympic Classification
Since the widespread adoption of functional systems of classification, Paralympic sport has continued to mature rapidly. Currently there are more than 15,000 registered competitors with the international governing bodies of the 25 Paralympic sports, and a much larger (but indeterminate) number of athletes compete at local and regional level in their home countries but are not registered internationally. At the elite level, successful Paralympic athletes are receiving increasing peer and community recognition and many receive commercial sponsorship and other financial rewards.

It is well recognised that the classification an athlete is assigned has a significant impact on the degree of success they are likely to achieve. Unfortunately however, Paralympic classification and classification research have not matured as rapidly as other areas of Paralympic sport and current Paralympic classification systems are still based on the judgement of a small number of experienced classifiers, rather than empirical evidence. As a consequence, the validity of the methods used in functional classification systems is often questionable.

*Threats to the validity of current classification methods*
In some instances classification methods have considerable face validity. For example, in a range of Paralympic sports (e.g., Wheelchair Tennis, Swimming, Sailing and Athletics) athletes with a complete spinal cord injury at C7 all compete in the same class, and this is a justifiable grouping

because the nature and distribution of impairments caused by a C7 injury will be approximately the same for all people and therefore the injury will have a similar impact on performance in sport. Moreover, lower lesion level is associated with reduced activity limitation and consequently athletes with a complete T8 lesion will compete in a different class to those with a C7 lesion. The methods for assigning class in the cases described is based on medical diagnosis and confirmatory clinical evaluation of muscle strength, together with observation of the athlete performing a range of sports-specific and non sports-specific tests. These methods are typical of those used in many functional classification systems and, for the cases described, the methods appear to be valid. However, as the following paragraphs illustrate, closer scrutiny indicates that there are significant threats to the validity of these methods.

In general, threats to the validity of functional classification methods result from two separate but related measurement issues:

- Measurement weighting; and
- Measurement aggregation.

The following illustrations of weighting and aggregation issues are based upon the current classification system for wheelchair racing for athletes affected by impaired strength.[10] However the principles apply across the classification systems used in Paralympic sports. There are four class profiles for wheelchair racing – T51, T52, T53 and T54 – the 'T' indicating the classes are for track racing and 51-54 indicating progressively decreasing severity of impairment. The class profiles are written in terms of loss of strength and may be summarised as follows:

- T51: Equivalent activity limitation to person with complete cord injury at cord level C5-6. (elbow flexion and wrist dorsiflexion strength to grade 5, a decrease of shoulder strength especially pectoralis major, and triceps muscle power from grade 0-3);
- T52: Equivalent activity limitation to person with complete cord injury at cord level C7-8 (normal shoulder, elbow and wrist strength, poor to normal finger flexors and extensors and wasting of the intrinsic muscles of the hands);
- T53. Equivalent activity limitation to person with complete cord injury at cord level T1-7 (normal arm strength with little or no innervation of abdominals and lower spinal muscles);
- T54: Equivalent activity limitation to person with complete cord injury at cord level T8-S4 (normal arm strength with a range of trunk strength extending from partial trunk control to normal trunk control).

*Measurement Weighting*

Measurement weighting refers to the relative influence of individual measures of impairment on the classification outcome. Based upon the profiles above, classification of an athlete who presents with a complete

cord injury at T2 would entail confirmatory diagnostic tests and clinical evaluation of strength using manual muscle testing as described by Daniels and Worthingham [11] and the resulting class would be T53. However the case of a person with a C6 incomplete injury who has some innervation of abdominals and lower spinal muscles, as well as impaired strength in the upper limbs is more complicated. Such a person has the same type of impairment as described in the class profile – impaired strength. However the distribution of the impairment is a mixture of the class descriptions. Consequently three main outcomes are possible:

- T52: this class will be assigned if the disadvantage caused by having less arm strength than T53 athletes is considered to be greater than the advantage conferred by superior trunk strength;
- T53: this class will be assigned if the disadvantage caused by having less arm strength than T53 athletes is considered to be equal to the advantage conferred by superior trunk strength;
- T54: this class will be assigned if the disadvantage caused by having less arm strength than T53 athletes is considered to be less than the advantage conferred by superior trunk strength.

In the case described, evidence-based decision making requires knowledge of the relative importance – or "weight" – of the trunk and arm muscles in relation to wheelchair propulsion. This knowledge would permit individual strength impairment scores to be meaningfully combined into a single 'wheelchair-specific strength impairment score', allowing athletes with different patterns of impairment to be meaningfully compared. Currently no such evidence exists and therefore decisions are made based on expert opinion. Opinion is usually informed by manual muscle testing of individual muscle groups, observation of sports specific and non-sports specific tasks and assessment of training history. [10]

Figure 2 (See Figure 2 at the end of the document) presents a hypothetical data set, plotting "wheelchair-specific strength impairment" (x-axis) against wheelchair racing performance (y-axis ). These data indicate that increasing impairment is associated with slower wheelchair racing time, but that the relationship is curvilinear: small changes in impairment on the left side of the graph are associated with relatively large changes in performance, while changes in impairment of a similar magnitude on the right side of the graph are associated with very small changes in performance. The hypothetical strength impairment associated with a complete T2 spinal cord injury is indicated, as are the three relative strength impairment scores associated with a C6 incomplete injury: C6a causing greater impairment than T2; C6b the same; and C6c less.

*Measurement Aggregation*
Challenges with aggregating measurements in classification are highlighted when a system classifies two or more different impairment types. Consider the case of a person with a complete spinal cord injury at T2 and

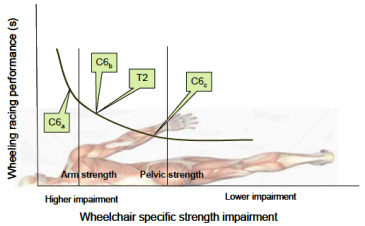


Figure 2: Hypothetical plot – Wheelchair Racing Performance vs. Wheelchair specific Strength Impairment. The hypothetical strength impairment associated with a complete T2 spinal cord injury is indicated, as are the three relative strength impairment scores associated with a C6 incomplete injury: C6a causing greater impairment than T2; C6b the same; and C6c less.

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*Measurement Aggregation*
Challenges with aggregating measurements in classification are highlighted when a system classifies two or more different impairment types. Consider the case of a person with a complete spinal cord injury at T2 and

right elbow extension deficit resulting from a co-occurring orthopaedic injury. In the absence of the elbow injury, the athlete would clearly fit in class T53. However the co-occurrence of a second type of impairment – decreased range of movement (ROM) – leads to two possible outcomes:
T52: this class will be assigned if the disadvantage caused by reduced elbow ROM in the right arm causes the same or more disadvantage than the bilateral arm weakness experienced by athletes in this class;
T53 this class will be assigned if the disadvantage caused by reduced elbow ROM in the right arm is relatively minor, and causes less disadvantage than the bilateral arm weakness experienced by athletes in the T52 class.

In this case evidence-based decision making not only requires knowledge of the relative importance of impaired elbow ROM and strength, but a valid means of summing – or aggregating – these scores, which are measured in different units: impaired ROM, measured in degrees; and impaired strength, currently measured using a 0-5 ordinal scale.[11] Evidence based aggregation would permit results from different impairment types to be meaningfully combined into a single 'wheelchair-specific impairment score', which would be the basis of class allocation. Currently no such evidence exists and therefore expert opinion is required.

Figure 3 (see Figure 3 at the endo of the document) presents a hypothetical data set, plotting "wheelchair specific impairment" (x-axis), a score based on aggregation of measures of wheelchair specific strength and range of movement, against wheelchair racing performance (y-axis). These data indicate increasing impairment is associated with slower racing time. The hypothetical impairment score associated with a complete T2 cord injury is indicated, as are the two relative impairment scores for T2 cord injury combined with impaired elbow ROM: T2 + elbow1 causing greater impairment and T2 + elbow2 causing a negligible increase in impairment.

## DEVELOPING EVIDENCE-BASED SYSTEMS OF CLASSIFICATION – TAXONOMIC REQUIREMENTS

The challenges associated with measurement weighting and aggregation highlights the principal shortcomings in current approaches to classification. The IPC recognises the need for systems of classification that are evidence-based and explicitly mandates the development of such systems in Section 15 of the Classification Code.[17] This section establishes the taxonomic pre-requisites needed for the development of sports-specific, evidence-based systems of classification.

What is an evidence-based system of classification?
In Paralympic sport, an evidence-based system of classification is one which:

- the system has a clearly stated purpose; and

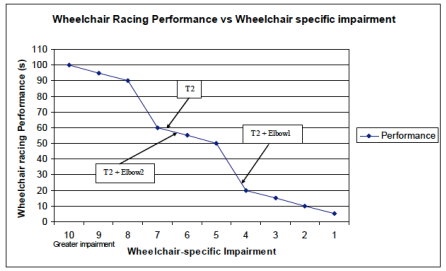


Figure 3: Illustrative graph – Wheelchair racing performance vs. wheelchair-specific impairment. T2 indicates wheelchair specific impairment caused by T2 cord injury with no other impairments; T2 + Elbow1 indicates wheelchair-specific impairment caused by T2 cord injury with elbow extension deficit causing 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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What is an evidence-based system of classification?
In Paralympic sport, an evidence-based system of classification is one which:

- the system has a clearly stated purpose; and

- • empirical evidence indicates that the methods used for assigning class will achieve the stated purpose.

To date, one of the most significant barriers to the development of evidence-based systems of classification is that many systems of classification either do not have stated purpose or have a statement of purpose that is ambiguous. For example many classification systems simply state that the purpose is to provide "fair and equitable competition". This statement is ambiguous because, as identified previously in this paper, fair and equitable sports competition can be achieved by both Performance Classification systems and Selective Classification systems. However the IPC is committed to the development of Selective Classification systems, so that athletes who enhance their competitive performance through effective training will not be moved to a class with athletes who have less activity limitation – as they would in a performance classification system – but will be rewarded by becoming more competitive within the class they were allocated.

*The Purpose of Classification*
To facilitate development of evidence-based systems of classification, all Paralympic systems of classification should indicate that the purpose of the system is to promote participation in sport by people with disabilities by minimising the impact of eligible types of impairment on the outcome of competition. This statement of purpose was first proposed by Tweedy [4] and is consistent with Section 2.1.1 of the Code which states that "Classification is undertaken to ensure that an athlete's impairment is relevant to sports performance and to ensure that the athlete competes equitably with other athletes". From a taxonomic perspective, adopting the proposed statement of purpose is critical because "impairment" is explicitly identified as the unit of classification, clearly aligning Paralympic classification with other Selective Classification systems used in sport (e.g., age, sex and body weight). When impairment is the unit of classification then the relative impact of other performance determinants – for example, volume and quality of training and psychological profile – is increased and the athletes who succeed will do so because they are stronger in these areas, rather than because they have an impairment that causes less activity limitation.

Conceptually, in order to minimise the impact of impairment on the outcome of competition, each classification system should:[4]

- Describe eligibility criteria in terms of:
  - type of impairment; and
  - severity of impairment;
- Describe methods for classifying eligible impairments according to the extent of activity limitation they cause.

These three dimensions of the purpose of classification are expanded under the headings below.

*Defining eligible types of impairment*
Sports should clearly identify which impairment types are eligible and define them according to the ICF codes. An example of the outcome of this exercise is presented in the IPC Athletics Classification Project for Physical Impairments.[10] To date only ten major types of impairment have been classified in Paralympic sport, these being vision impairment, impaired strength, impaired range of movement, limb deficiency, leg length difference, hypertonia, ataxia, athetosis, short stature and intellectual impairment (see Figure 1). Section 5 of the Code indicates that the type of impairment must be permanent,[17] indicating that it should not resolve in the foreseeable future regardless of physical training rehabilitation or other therapeutic interventions.

It is important to note that many health conditions that cause eligible impairment types affect multiple body structures and functions. For example, in addition to impaired strength, spinal cord injury may also result in impaired sensation (tactile sensation, proprioception or pain), impaired thermoregulatory function and impaired cardiac function. While some of these associated impairment types may have a significant impact on sports performance, expansion of the types of impairment that are classified in Paralympic sport has the potential to have a significant impact on the culture and fabric of Paralympic sport and should therefore be approached cautiously. Furthermore, every Paralympic sport does not classify all major impairment types and nor are they obliged to. For example, vision impairment is not currently classified in wheelchair sports, and loss of strength is not assessed in judo or goalball. Which of the ten impairment types is classified in a given Paralympic sport is a matter for each sport to decide. Once decided, the impairment types classified should be clearly stated.

Note that while it is theoretically possible to develop systems of classification in which people with all 10 types of impairment compete together, this approach is not favoured by the IPC.
Rather, as Tweedy has previously proposed,[12] there are sound taxonomic reasons for treating the ten eligible impairment types as at least three distinct groups: a) biomechanical impairments, comprising the eight impairments that cause activity limitations that are biomechanical in nature – impaired strength, impaired range of movement, limb deficiency, leg length difference, hypertonia, ataxia, athetosis, and short stature; b) vision impairments and c) intellectual impairments. Biomechanical impairments may also be referred to as neuromusculoskeletal impairments (which is consistent with the ICF but which is less informative in a sports context) or physical impairments (which is simple but less precise).

*Defining eligible impairment severity*
Section 5 of the Code indicates that in order to be eligible, an impairment must impact on sports performance.[17] To ensure that only impairments

which impact on the sport are eligible, each Paralympic sport should develop minimum disability criteria. More specifically, each Paralympic sport should identify those activities that are fundamental to performance in that sport, and then operationally describe criteria for each eligible impairment type that will impact on the execution of those fundamental activities. For example, determination of minimum disability criteria for vision impairment in alpine skiing should be set by analysing the vision requirements for optimum downhill performance - visual acuity, visual field, contrast sensitivity etc – and then, once they have been identified, developing an operational description of the minimum vision impairment/s that will sufficiently compromise those requirements to be considered eligible.

There are two important consequences arising from accurately described minimum disability criteria:

- It will be possible for an athlete to have an eligible type of impairment but to be ruled ineligible because the impairment does not meet the relevant minimum disability criterion. For example, while a person who has had a single toe amputated is technically an amputee (an eligible type of impairment), the impairment does not cause sufficient activity limitation in running and therefore does not meet the minimum disability criteria for IPC Athletics [10]; and
- Minimum disability criteria will be specific to each sport. Consequently it will be possible for a person to have an impairment that is eligible in one sport, but not in another.

Note that minimum disability criteria should describe impairments that directly cause activity limitation in the sport and should exclude impairments that may cause activity limitation in training but do not directly impact on activities that are fundamental to a sport. For example, although the loss of the fingers on one hand will cause activity limitation in certain resistance training exercises considered important in sprinting (e.g. the snatch and the power clean), the impairment will cause negligible activity limitation in the sprint events themselves and therefore such an impairment is not eligible in IPC Athletics.[10]

To some extent determining how much activity limitation will be sufficient is affected by sports culture and more than one view may sometimes be considered valid. Consequently determination of minimum disability criteria should draw on empirical evidence when it is available, but also ensure that it reflects the views of key stakeholders in the sport – athletes, coaches, sports scientists and classifiers.

Classifying impairments according to extent of activity limitation caused
Impairments which meet the eligibility criteria should be divided into classes according to how much activity limitation they cause. To date a number of other phrases have been used to describe the conceptual basis of classification in Paralympic sports. Table 2 identifies two of the main

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

| | | | | |
|---|---|---|---|---|
| | | | | Federation |
| Swimming | Wheelchair Rugby | IWAS | Volleyball (Sitting) | World Organization for Volleyball for Disabled |
| Wheelchair Dance Sport | | | Wheelchair Basketball | International Wheelchair Basketball Federation |
| | | | Wheelchair Tennis | International Tennis Federation |
| | | | Wheelchair Curling (W) | World Curling Federation |

Acronym Key: IOSD (International Organizations of Sport for the Disabled); Cerebral Palsy International Sport and Recreation Association (CPISRA); International Blind Sport Association (IBSA); International Wheelchair and Amputee Sports Federation (IWAS); Winter sport denoted by (W).

Table 2: Previously proposed statements regarding the conceptual basis of Paralympic classification and why they are unsuitable

| Conceptual basis | Problem with this conceptual basis |
|---|---|
| Place athletes into classes according to their **degree of function** | Although function is affected by impairment, a range of other factors also affect how well a person functions. These factors include age, fitness, motivation. A person who is old, unfit and unmotivated will not function as well as when they were young, fit and motivated. Moreover, we know that training affects function – if it did not, then athletes would not train. If athletes was placed into classes according to function, then an athlete who was young, motivated and well trained would be placed in a more functional class than someone who was older, unmotivated and poorly trained. Paralympic systems of classification should ensure that young, well-trained athletes should gain a competitive advantage and therefore classifying athletes according to their degree of function is not a suitable conceptual basis for classification in Paralympic sport. |
| Place athletes into classes according to their **degree of performance** | The performance potential or innate potential of an athlete is determined by an array of natural attributes including, but not limited to, impairment. For example in discus, performance potential or innate potential is |

| | |
|---|---|
| **potential** or **innate potential** | obviously negatively influenced by impairment strength. However performance potential is enhanced by increased standing height, arm span and increased proportion of type II (fast twitch) muscle fibres. If athletes were classified according to such constructs, then tall athletes with long arms and an ideal muscle fibre composition would compete in higher classes than short, endurance-type athletes. Paralympic classification systems should ensure that athletes with the best combination of natural attributes have a competitive advantage over others, therefore classifying athletes according to their performance potential is not a suitable conceptual basis for classification in Paralympic sport. |