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Classification and Intellectual Disabilities: An investigation of the factors that predict the performance of athletes with Intellectual Disability

Rosanna Gilderthorp

Canterbury Christ Church University, Kent, UK

Jan H. Burns

Canterbury Christ Church University, Kent, UK

Fergal Jones

Canterbury Christ Church University, Kent, UK

Correspondence concerning this article should be addressed to Jan Burns, School of Psychology, Politics and Sociology, Canterbury Christ Church University, North Holmes Road, Canterbury, Kent, UK, CT1 1QU. Email: jan.burns@canterbury.ac.uk

Abstract

It has been shown that having intellectual disabilities impacts to reduce performance compared to athletes without this impairment. However, it has also been demonstrated that there is a not a direct link between intelligence and athletic performance. To advance elite ID sport more needs to be understood about the relationship between this impairment and sporting performance. This is vital if competition classification systems are to be based on theory and evidence. This study used the *International Classification of Functioning, Disability and Health* (ICF) as an approach to classification and examined the impact of multiple health problems on athletic performance. A health survey was administered to two groups of athletes with ID: elite and regional level athletes. Athletes with Down Syndrome were also identified. Overall disability scores predicted sporting performance, but not IQ or Down Syndrome. The implications of these findings are discussed with reference to the ICF framework and classification.

Classification and Intellectual Disabilities: An investigation of the factors that predict the performance of athletes with Intellectual Disability

Athletes with intellectual disabilities (ID) were re-included into **the London 2012 Paralympics games**. **There has been much debate surrounding the rules of the Paralympic games, as all participants with ID compete against each other in the same class, (Burns, 2017), despite the vast range of severity of impairment that athletes may present with.** However, to develop a more stratified approach, **similar to other impairment groups**, research must be undertaken, upon which a more sensitive classification system could be based. It is the purpose of this paper to explore how such a system could be developed.

The definition of **I**ntellectual **D**isability **includes the following criteria:** a significant impairment in intelligence, significant impairment in adaptive behaviour and onset during the developmental period (usually taken as before age 18, which distinguish**es** ID from acquired brain damage) (World Health Organization, 2015). All **three criteria** should be assessed equally and given equal weighting (Schalock et al, 2010). Hence, ID is a composite of impairment in intellectual functioning and limitations of independent functioning, both of which **are** present since early life. **The impact of intellectual disabilities has reflexive circularity, meaning limitations in capacity** serve to further limit learning opportunities, adding to the overall impairment.

To add to the complexity many people with ID have co-morbid health issues. Some of these are related to genetic syndromes such as Down Syndrome, which has associated respiratory, skeletal, muscle tone, cardiac, and other **physical**

problems, in addition to intellectual impairment. **Other co-morbid health issues arise from damage to the central nervous system occurring prenatally or postnatally**. These conditions include epilepsy, cerebral palsy, and sensory deficits, such as auditory and visual impairments (Hatton, 2012; McLaren & Bryson, 1987). **In addition to primary** health conditions, **life style limitations and choices put people with ID at risk of developing secondary health conditions such as diabetes, heart disease and obesity** (Emerson & Hatton, 2013). Studies of the prevalence of **co-morbid** t medical conditions show significantly higher rates in individuals with ID across a wide range of disorders, as compared to the general population (Schieve et al. 2012). Having a co-morbid **health condition can have an adverse impact** upon an individual's adaptive functioning, in addition to and in combination with the limitations imposed by intellectual impairments. Hence, having ID often **results in** living with a combination of both intellectual and health conditions. Indeed, Nakken and Vlaskamp (2007) called for a new multi-axis taxonomy in the area of ID, recognizing the prevalence of motor, sensory, and mental health problems.

Previous researchers have recognized that there is no direct link between sporting performance and intelligence (Van Biesen, Mactavish, McCulloch, Lenaerts, & Vanlandewijck, 2016). However, for people with ID, impairments have been shown to impact their performance, such that even at the highest **level of athletic performance,** their achievements do not replicate those of people without ID (Burns, 2015). Understanding this complex relationship has important implications for the development of elite sports for athletes with ID, where the classification of different levels of impairment is fundamental to competition.

Within **International Paralympic Committee (IPC) competition** '**classes' are defined which group similar levels of severity of impairment together**. **This is to** 'ensure that an athlete's impairment is relevant to sport performance and to ensure that the athlete competes equitably with other athletes' (Article 2.1.1, International Paralympic Committee Classification Code, 2007). For example, within swimming, there are ten classes for athletes with physical impairments and three for swimmers who are visually impaired. In contrast, athletes with ID currently have only one class when competing in IPC sanctioned events or within events sanctioned by the International Federation for Para Athletes with Intellectual Disabilities (INAS)[1]. If elite sports for ID athletes are to develop in a similar way as those in other impairment groups, it would seem appropriate for the one ID class to evolve into multiple classes, recognizing the severity of the intellectual impairment. However, if the assumption that there is not a direct relationship between intelligence and sporting performance is true, it would not be appropriate to divide classes by intelligence alone. Although a deficit in intelligence is a key diagnostic factor in determining the presence of ID, other factors, such as level of adaptive functioning and age of onset, must be considered with equal weighting and with respect to the individual's developmental history and context. **Hence,** d**eveloping multiple classes for people with ID to compete within presents a challenge because many diagnostic factors must be examined.**

For a classification system to operate and adhere to the IPC model, it must be based on functional, rather than diagnostic, categories (Tweedy & Vanlandewijck, 2011). It must also be based on clear taxonomic theory and evidence, both of which

[1] The International Federation for Para Athletes with Intellectual Disabilities (INAS) is the international sports federation responsible for developing competitive sport for people with intellectual disabilities.

Tweedy (2002) suggested have been missing from ID elite sport classification. In terms of classification in ID sport, simply dividing categories based on IQ is not acceptable, not only because of the lack of evidence of a direct relationship between IQ and sports performance, but also because it does not take account of the co-morbid health issues. For example, an athlete with Down Syndrome may have mild cognitive impairment, but due to associated physical impairments, would not be able to compete fairly with an athlete with a similar intelligence quotient (IQ) without any genetic condition. **Within the population of people with ID Down Syndrome is the largest known sub-group** (Hatton, 2012), so to develop an elite sport classification system **for athletes with intellectual disabilities** which places this group, and others with known genetic conditions, at a clear disadvantage is unjustifiable. In addition, it can be argued that the current system privileges individuals whose impairments are not representative of the ID population as a whole. A classification system that takes account of the overall functioning of an athlete with intellectual disabilities, regardless of the genesis of that problem, seems a more appropriate avenue.

Tweedy (2002) came to a similar conclusion and advocated a ‘unified’ system across all impairment groups. Tweedy (2002) confirmed the link between the International Paralympic Committee model of sports classification and that of the *World Health Organisation, International Classification of Functioning, Disability and Health* (WHO-ICF). The WHO-ICF is a multipurpose classification system that provides a common language and conceptual basis for the definition and measurement of disability and integrates the medical and social model into a ‘biopsychosocial’ synthesis (WHO ICF Manual, 2013). The ICF model improves upon other taxonomies to better reflect the complex interrelationship between physical, personal, and environmental factors (Luckasson & Schalock, 2013). It also plots a clear trajectory between initial disorder, impairment, and disability. The ICF model was designed to complement the WHO diagnostic framework of the *International Statistical Classification of Diseases and Related Health Problems 10* (WHO ICD-10, 2011) and to take a whole person approach. Tweedy (2002) presents a thorough review of the applicability of the ICF to sports classification, suggesting that the ICF's model and the International Paralympic Committee system of sports classification are 'highly connected in terms of purpose' and have 'close conceptual links' (p. 223). Tweedy cites a number of compelling reasons to use the ICF approach in sports classification, including the opportunity to enrich the theory behind classification, to capitalize on the substantial resources invested by WHO to develop and promote this framework, and to take advantage of a globally accepted and increasingly used approach. Furthermore, both the ICF and the IPC taxonomies are concerned with the overall functioning of the individual, **associated with their level of disability, which has resulted** from compromised health (disorder or disease). However, the ICF framework takes a broad biopsychosocial approach, where health status is seen as the outcome of impairments of body functions and structure, integrated with activity and participation, and positioned within the context of environmental and personal factors (WHO, 2011). **In contrast**, in the IPC model the approach is less broad, being primarily concerned with type and level of impairment (significant deviation or loss of body function or structure).

Whilst conceptually very appealing, developing such a **'unified'** approach for classification of ID athletes remains a challenge at a practical level and advancing such a system must be based on robust research evidence. A first step towards this is to understand more about the prevalence of comorbid conditions in athletes with

ID, as it is likely that adaptive functioning will be influenced by the existence of such conditions in combination with intellectual impairment. Secondly, it seems intuitively likely that as the severity of the intellectual impairment increases, so might the number and/or severity of comorbid health conditions, as it would be unusual for severe trauma to the central nervous system to affect intellectual abilities in isolation. Nevertheless, the research detailing this relationship is limited, rudimentary, and very dated. In the only review that directly addresses the issue of prevalence of additional disorders in relation to IQ, McLaren and Bryson (1987) conclude that 'the number of associated disorders increases with the severity of retardation' (p. 247). Finally, if a classification system based on overall functioning were to be viable, one would expect a relationship between sports performance and the combined functional severity of intellectual and co-morbid health status.

This study aimed to examine the relationship between IQ, additional impairments, and sporting performance as a means to further explore the viability of introducing additional classes to elite sporting events for athletes with ID. More specifically, it sought to test three hypotheses. The first addressed the relationship between IQ and comorbid conditions and suggested that there would be a negative correlation between IQ and level of additional functional disability. Hypothesis two related to the idea that IQ is not directly linked to sporting performance, whereas physical or sensory impairments will impact adversely on sporting performance. Therefore, it was hypothesised that a total physical/sensory disability score would be a significant predictor of athletic performance, while IQ was not expected to directly predict performance. To ensure that this approach **adequately** distinguished between diagnosis and functional ability, the third hypothesis was that a diagnosis of Down Syndrome would not predict performance **independent of** physical/sensory disability.

Method

Design and Participants

A between groups design was employed. Health, athletic performance and IQ information was collected from a convenience sample of participants in two pre-existing groups: elite athletes competing within INAS sanctioned international events and regional level athletes taking part in national sports training and competition. These two groups were chosen to reflect different levels of performance - those at the elite, international level and those competing at a more recreational level. **The grouping then** allowed for two measures of athletic performance, group membership, based on the assumption that INAS athletes should be performing at a higher, “elite level”, and an independent performance calculation based on competition results. It was considered useful to **use** two measures of performance as it was not possible to calculate independent performance scores for team sports. Data on the performance of all participants competing in individual sports was collected through published competition results.

Participants were required to be: an athlete who had taken part in an INAS or regional level sport event in the past 12 months; over 18 years of age; eligible to compete as an ID athlete according to the definition provided by WHO (2015), including having an IQ below 75[2] on a standardised measure, accompanied by a supporter who they trusted and who was familiar with their medical history and able to provide support should it be needed. Originally, 111 participants were recruited (INAS=28, regional=83). **Two** from the regional group were excluded because they were unable to give consent, a further two **participants were excluded** as a familiar supporter was not available **to assist them in the interview**. Finally, from the **regional** group, 11 were excluded as they were screened to have an IQ above 75. **The final total number of participants was** 96 (INAS =28, regional=68). No INAS athletes were excluded due to the fact that athletes competing with INAS have already been through an eligibility process that ensured that they met the criteria for IQ.

Both the INAS and regional samples contained more men than women, which is typical of such sporting events. Overall 81 men and 29 women initially opted in to the study. Athletes were recruited at sporting events **that took place** in the Czech

2 This is the IQ cutoff point used by INAS

Republic, Italy, and the UK. The gender breakdown, nationalities, and variety of sports represented are detailed in Table 1. From these samples, 35 participants were people with Down Syndrome.

Measures and Materials

Health measure.

The purpose of **using** the health measure was twofold: to record the types of physical impairments present and to assess their severity in terms of impact on functioning. The ICF framework and approach to assessment has worldwide acceptance. It has been used to guide clinical measurements and evaluations of people requiring special education and disability support and has also been used to measure the health status of general populations in 71 countries (Chiu et al, 2013; Üstün, Chatterji, Bickenbach, Kostanjsek & Schneider, 2003). It has also been advocated as an approach well suited to sports classification (Tweedy, 2002). Hence, for these compelling reasons, this approach **to classification** was taken in this study.

As the full ICF taxonomy extends to 1,400 codes organized in a hierarchical structure with three levels of detail, a shorter generic checklist has been developed: the ICF Checklist V2.1a (WHO, 2011). This contains 128 codes, covering in Part 1a ‘Impairments of Body Functions’, Part 1b ‘Impairments of Body Structures’ and in Part 2 ‘Activity Limitations and Participation Restriction’. Part 1a and 1b include eight main domains: Mental functions, Sensory Functions and Pain, Voice and Speech Functions, Functions of the Cardiovascular, Haematological, Immunological and Respiratory Systems, Genitourinary and Reproductive Functions, Neuromusculoskeletal and Movement Related Functions, Functions of the Skin and

Related Structures, and Any Other Body Functions. The ICF checklist has been reported to have good reliability, sensitivity, and validity when assessing rehabilitative outcomes across a range of impairments (Kohler, Xu, Withmory & Arockiam, 2011; Almansa et al, 2011; Zhu, Qui, Zhang et al 2004).

As the ICF checklist has been used flexibly in previous research (e.g. Roe et al, 2013; Kahn & Pallant, 2007), **several adaptations were made to it to meet the aims of the present study**. As our purpose was to assess the existence of a range of additional functional impairments, only Part 1a of the ICF checklist, which focuses on ‘Impairments of Body Functions’, was administered. This covered all of the **eight** domains above and asked participants to describe whether they experienced any functional difficulties relating to each domain. It was not necessary to administer Part 1b or Part 2 of the checklist, as the primary focus of the study was on functional impact. **Part 1b focusses on ‘Impairments of Body Structures’ and whilst an impairment may exist it may or may not impact on functionality which is the focus of this study. Part two focusses on the wider, general consequences of impaired body function and/or structure, which again was not the focus of this study**. **These adaptations** also allowed the questionnaire to be kept relatively short at 30 items. Some additional specific health problems, **that were not included in the checklist** were also asked about directly in order to capture diagnoses that have been found to have significantly increased prevalence in people with intellectual disability. These **items** included epilepsy, Autism Spectrum Disorders, and Attention Deficit Hyperactivity Disorder (Carr & Reilly, 2007), **and were administered in the same format as the rest of the checklist**.

The ICF checklist was administered through a specially designed semistructured interview. In this study, as the participants were athletes with ID, they were assisted by a trusted adult with good knowledge of their health history and the language **within the checklist** was simplified **when necessary**. The presence of supporting adults was deemed necessary **because** when the measure was piloted **as part of this study** participants **reported** that it could be stressful to try remembering their health history without support. Interviews took between 15 and 30 minutes to complete depending on the health problems discussed and the communication needs of the participant. However, to ensure consistency, the interview was carefully scripted, with additional suggested prompts. The aim **of this study** was to obtain as much detail and certainty as possible through mutual discussion with both informant and athlete, **but the extent to which this was achieved varied across respondents.**

To assess the severity of the **functional impairment**, the following ICF qualifier codes were used: no difficulty (0), mild difficulty (1), moderate difficulty (2), severe difficulty (3) and complete difficulty (4). The checklist was scored following the ICF guidance. **This resulted in** a ‘total disability’ score, reflecting the number of disabilities held by an individual, and a ‘severity of disability’ score, summing the severity of each reported impairment. These two scores are summed to create an overall disability score.

Prior to data collection, the measure was piloted on five individuals from the population of interest. This was primarily to ensure the face validity and feasibility of the interview as well as checking that the language used was accessible to people with ID and their supporters. Interviews were carried out by the first author or by research assistants who had been trained in the administration of the survey and who had previous clinical experience working with people with ID. This was deemed essential as researchers used their clinical skills to ensure that participants were fully informed and had capacity to engage in the process. To check inter-rater reliability, a sample (*n*=26) was independently rated. Perfect agreement was found in 65% of cases, while 88% of cases fell within two points difference on the overall disability score, indicating acceptable inter-rater reliability (Stemler, 2004). The scoring of all surveys was either completed or checked by the first author to further ensure consistency.

Performance measure. A standardized performance score was generated for each athlete competing in individual events by taking a recent result from a competitive sporting event and creating a percentage score based on the world record for that event for the appropriate gender. Swimming world records were taken from the Federation Internationale De Natation (FINA) website. Athletics world records were taken from the International Association of Athletics Federations. All records were correct as of August 2014. The following formula was used to calculate the performance measure: Performance = (a/w) x 100, where a=athlete’s time/distance and w=world record time/distance.

Where possible, the result was taken from the athlete’s best performance at the sporting event from which they were recruited. If this was not possible, a “personal best” taken from a recent competitive event was accepted. If participants competed in more than one sport, the sport in which they had the highest performance level was selected. It was not possible to create standardized performance scores for athletes whose sole sporting activity did not produce an outcome that was measurable in time or distance (e.g., football and tennis players). These participants (*n*= 46) could not, therefore, be included in analysis of performance, but were, nevertheless, included in the analysis of the correlation between IQ and additional physical disability.

IQ measures. INAS records were accessed, with permission from participants, in order to gain IQ scores for the INAS athletes group. Participants from the regional events, who did not compete with INAS, were administered the Wechsler Abbreviated Scale of Intelligence (WASI or WASI-II, depending on availability). This is a psychometric assessment designed to give an indication of an individual's overall level of cognitive functioning (IQ) based on their performance across diverse tasks. For a brief screening of IQ using the WASI, it is recommended that two of the four subtests (vocabulary and matrix reasoning) be used (Wechsler, 1999; 2011). Both the WASI and WASI-II have strong reported psychometric properties (McCrimmon & Smith, 2013; Wechsler, 2011; Homack & Reynolds, 2007; Wechsler, 1999). Split half reliability coefficients have been found to be excellent for the two subtest full scale IQ (Full Scale IQ-2) of the WASI (Wechsler, 1999). The split half reliability coefficients for the WASI-II for the full scale IQ score (generated from all four subtests) and the full scale IQ score (generated from just two subtests) were also judged to be excellent, ranging from .90 to .96 (McCrimmon & Smith, 2013).

The WASI-II was used as an intelligence measure, where possible, due to its improved concurrent validity with the Wechsler Adult Intelligence Scale – Fourth Edition (WAIS IV), the IQ assessment most commonly used in **the diagnosis of intellectual disabilities** (McCrimmon & Smith, 2013). However, both tests have demonstrated excellent convergent validity with other standardised tests commonly used to assess IQ, such as the Wechsler Adult Intelligence Scale – Third Edition and the Wechsler Intelligence scale for Children – Third and Fourth Editions (Homack & Reynolds, 2007; McCrimmon & Smith, 2013). If English was not the athlete's first language, the Perceptual Reasoning Index (PRI) was taken as an estimate of IQ (*n*=16). The PRI consists of two subtests— block design and matrix reasoning. There is strong rationale for using the PRI as an estimate of overall IQ for research purposes, as the subtests required to generate the PRI are deemed to be less reliant on spoken English and western acculturation, while still providing a good estimate of cognitive ability (Razani, Murcia, Tabares & Wong, 2007).

Procedure

Prior to competitions where the athletes were competing information was sent out **about the study and asking the athletes if they would like to participate.** In order to minimize disruption to participants, the interviews and IQ screenings took place in a private area close to the sporting events, at a time chosen by the participants and their supporters. **The interview process** could be prior to competing, between events or after competing depending on their preference. **The information sheet was presented first,** giving a chance for questions and the consent forms **were** completed. All participants were **then** asked to complete a brief demographic questionnaire and the health survey (15-30 minutes) with a familiar adult available to support them in remembering their medical history. As IQ scores were **previously** available for INAS athletes, **only** regional level athletes were then asked to complete either the WASI or the WASI II. The demographic questionnaire was completed first, then the WASI **or WASI II** (when required) solely by the athlete. Both supporters and athletes were interviewed together and encouraged, by the interviewer, to come to a consensus of opinion by the interviewer when responding to the ICF checklist. Competition results for all athletes were gained from the event organisers or lists of results published online.

Ethical considerations

The study gained ethical approval from a University ethics panel prior to the commencement of recruitment. In order to ensure that athletes were given adequate time to understand the nature of the study and to make an informed decision about participating, specially designed information sheets were distributed to the coaches of sports clubs that were due to attend recruitment events. Written consent to participate was obtained by the researchers, who sought to ensure that participation was voluntary and that the participants understood the contents of the information sheet prior to providing consent. All athletes were accompanied by a trusted adult who helped to ensure communication between the athlete and the interviewer was meaningful. Participants were excluded if **s/he**, their supporter, or the researcher felt they did not have the ability to provide informed consent. **Two participants from the regional group were not able to provide informed consent and were excluded.**

Data analysis

The data was analyzed using the SPSS v22 statistical analysis software (IBM Corp, 2011). Descriptive statistics and simple t-tests compared the INAS and regional groups standardized performance, total disability, and IQ scores. Hypothesis one was tested by a simple Spearman's correlation between IQ scores and total disability scores. A one tailed test of significance was used, as a negative relationship between groups, performance, disability and IQ was hypothesized (McLaren & Bryson, 1987).

A linear regression with standardized performance as the outcome variable was used to test both hypotheses two and three, with both IQ and total disability score entered as predictors. Down Syndrome was then entered into both analyses as a predictor, and the predictive power of the model was re-assessed. The sample size of n=65 for the linear regression was sufficient to detect a large effect, with a power of 0.8 (Miles & Shevlin, 2001).

Results

Key characteristics of the participants are shown in Table 1.

Insert Table 1

Descriptive statistics showed a non-statistically significant difference in mean performance scores between INAS (mean = 158.43, SD = 25.29) and regional athletes (mean = 186.98, SD= 65.29, *t* (74) = 1.85 *p* >.05). As might be expected, the mean total disability score was statistically significantly lower for INAS athletes (mean = 12.11, SD = 16.78) than regional athletes (mean = 21.9 SD=18.44, *t* (103) = -2.46, *p* <.05). The mean IQ score was also statistically significantly higher for INAS athletes (mean = 58.56, SD = 10.34) than for regional level athletes (mean = 53.42, SD = 8.04, *t* (85) = 2.68, *p* = <.05).

Hypothesis one: There will be a negative correlation between IQ and total disability score

Spearman's rho was used as a non-parametric correlation coefficient as significant skew and kurtosis were detected for the total disability variable and a slight kurtosis was detected in the IQ score. This was to be expected, as the data was collected from a population with known high levels of disability. There was a significant, negative relationship between total disability scores and IQ scores, r_s = -.22, p (one tailed) < .05. This indicates that as level of IQ decreases, level of additional disability, as measured by the total disability score, increases. Hence, hypothesis one was supported.

Hypothesis two: Total disability score, but not IQ alone, will negatively predict athletic performance

A linear regression **was conducted,** with standardized performance score as the outcome was carried out. In order to test the hypothesis, IQ scores and total disability scores were entered as predictors. The linear regression model was significant ($p<.001$) and R^2 indicated that it explained 26% of the variance in performance standardised scores. As hypothesised, total disability score was a significant predictor (β =.47, $p<.05$), whereas IQ was not (β =-.13, n.s.). Higher levels of disability predicted worse performance, as indicated by higher performance standardized scores. When IQ was removed from the model, the change in model fit was not significant (change in R^2 =-.02, n.s.), confirming that it did not make a significant contribution.

The model was assessed using the guidance provided in Field (2009). No significant problems were found upon inspection of the standardized residuals. Although one outlier was identified using Cook's distance, removal of this case did not significantly improve the predictive power of the model, so it was retained. Assumptions were checked and no multicollinearity was found according to the Durbin Watson test, and the assumption of homoscedasticity was met. However, the Kolmogorov-Smirnov test revealed that the assumption of normality had been violated ($p<.05$). Therefore, bootstrapping was] applied as a robust form of regression that does not rely on the assumption of normality (Field, 2009). The results confirmed the findings of the linear regression as the confidence interval **of the** disability total score did not cross 0 [95% CI = (0.28, 2.68)], **which indicated** it was a significant predictor of performance standardized score. The confidence interval for IQ crossed zero, confirming that IQ was not a significant predictor [95% CI = (-2.06,0.44)]. The regression was then run again, with IQ removed as a predictor. The results indicated that that the removal of IQ did not significantly affect the overall fit of the model, with or without bootstrapping. The confidence interval for disability total score did not cross zero [95% CI = (0.27,2.66)].

In summary, the hypothesis that total disability score would predict performance was supported. The hypothesis that IQ would not be a significant predictor was also supported.

Hypothesis three: Down Syndrome will not be a significant predictor of athletic performance when total disability score is controlled for.

The significant linear regression model with total disability score as sole predictor was repeated. Down Syndrome was then entered into this model at step two, to test hypothesis three. The new linear regression model indicated that the addition of Down Syndrome as a predictor did not significantly improve the model, as the change in R^2 was not significant (change in R^2 =.02, n.s). As with the previous linear regression, the assumption of normality was violated and bootstrapping was applied as a robust form of regression that does not rely on the assumption of normality (Field, 2009). The results confirmed that total disability score remained the only significant predictor of performance, as the confidence intervals produced for this predictor did not cross zero [95% CI = (0.10, 3.286)] while the confidence interval for Down Syndrome did cross zero [95% CI = (-57.53,17.89)].

In summary, the hypothesis that Down Syndrome would not add predictive power to the model was supported. **This indicated** that there was not something specific to Down Syndrome which predicted athletic performance; it **was** the overall level of functional ability as measured by the amended ICF checklist that predicted performance.

Discussion

The results suggest that there is a negative relationship between IQ and level of additional disability, as measured by the total disability score. **Supporting the theory that the lower the IQ, the higher the number of co-morbid medical disabilities, and consistent with the findings of the epidemiological review carried out by** McLaren and Bryson (1987).

It is interesting that the link between IQ and level of additional disability was replicated, even within a sporting population where it might be expected that the sample would be biased towards more physically able individuals. This link between IQ and co-morbidity strengthens the argument made by Nakken and Vlaskamp (2007), that ID should be seen as a constellation of intellectual, sensory, and physical impairments, which potentially combine to compromise functioning. This **conceptual framework** is especially important when considering the athletic performance of athletes with ID, as physical and sensory impairments may be overshadowed by the intellectual impairment. **In such cases** lower athletic performance is related solely to intellectual impairment when in reality it is a result of the combination of sensory, physical and intellectual impairment. The extent of such unrecognized comorbidity is further supported by research into the Special Olympics, through analysis of their ‘Healthy Athletes’ program. This is a health screening program that is run at major Special Olympics sporting events. For example, Hild, Hey, Baumann, Montgomery, Euler and Neumann (2008) found 13% of the 552 athletes with ID they tested through the program had undetected hearing loss and 42% were advised to seek further specialist assessment. In terms of podiatric screening**s**, Jenkins, Cooper, O’Connor and Watanabe (2012) found 20% of the 4,094 Special Olympics athletes screened required referral to a specialist.

Furthermore, some evidence from elite athletes with ID suggests the presence of less obvious physical differences in the population, including differences in upper body speed (Van Biesen, Verellen, Meyer, Mactavish, Van de Vliet & Vanlandewijck, 2010). Indeed, other more subtle differences, which may not be classified as impairments, but are implicated in sports performance, have been found to differ in adults with ID, specifically balance and manual dexterity. In a 30 year follow up study, Lahtinen, Rintala and Malin (2007), found differences in balance and manual dexterity, as well as a negative association with IQ. Differences in postural balance, manual dexterity, and muscle strength have all been demonstrated and the negative association with IQ levels replicated (e.g. Blomqvist, Olsson, Wallin, Wester, & Rehn, 2013; Franciosi, Baldari, Gallotta, Emerenziani, & Guidetti, 2010; Vuijk, Hartman, Scherder, & Visscher, 2010).

Level of additional physical disability, as measured by a total disability score, was found to be a significant predictor of performance, as measured by a standardized performance score, with greater levels of physical disability predicting reduced performance. The same predictive power was not found for IQ when physical disability was controlled for, supporting the view that intelligence is not directly associated with sporting performance (Van Beisen, 2016; Burns, 2015, Dexter, 1999). This finding supports the **argument** that to develop additional classes within ID sports, a simple classification by IQ is unlikely to be adequate, whereas using a global functional disability index would be more appropriate.

Finally, the hypothesis that Down Syndrome would not add any additional predictive power to the models was supported. This result is, perhaps, unsurprising given the links between additional physical disability, IQ, and performance described above. However, the findings provide further evidence that it is likely to be the increased levels of physical disability associated with genetic conditions, such as Down Syndrome, that prevent athletes reaching elite level in their sports, rather than the diagnosis in **and of** itself. Essentially, the impairments associated with Down Syndrome vary in severity, and it was the severity of the overall level of functional disability, **not the membership of the group Down Syndrome, which linked performance to impairment.**

A strength of the present study is that the sample attempted to represent the international community of athletes with ID, rather than focusing on a single sports organization (e.g. Special Olympics). The present study also investigated an under-researched, but important area. There are, however, some methodological limitations that should be acknowledged. The use of a convenience sample meant that several factors that may have affected sports performance, such as gender, age, socioeconomic background, and length of time competing in chosen sports, were not controlled. There was also insufficient power to add these factors as potential moderators into the regression models used, so their potential impact could not be assessed. There was also some variability in the use of IQ measures used, although they were all from the Wechsler family and had been standardized against each other. However, their primary use was as a screening method to ensure that participants met one of the criteria of the definition of intellectual disabilities, not as a formal diagnostic tool. All participants met the 'social model' criteria by already being included in sporting activities for people with ID. The fact that 11 participants from the regional group were excluded for having an IQ above 75 draws attention to the differences in describing the population through IQ compared to the social model.

The health interview was based on a reliable and valid tool developed by the World Health Organisation. The fact the findings generally concur with those reported by McLaren and Bryson (1987) suggests validity. However, the reliance on the self-report of athletes and information provided by their supporters may limit the validity of the measure. Moreover, the prevalence rates of health conditions may have changed considerably since 1987. It was noticeable that cultural barriers prevented discussion of some particular disabilities, for example epilepsy and mental health diagnoses. **Hence, the** numbers of participants with these conditions **may have been** underestimated. In addition, some people who appeared to be coping with a variety of complex physical health problems did not report their issues, as they did not subjectively view them as problematic. This attitude was sometimes mirrored in their **supporters who, given the sporting context, may be more prone to focus on achievement, rather than taking a more, clinical, problem orientated view of the athlete with ID.** This was particularly noticeable for the athletes with Down Syndrome interviewed, as they often viewed their physical health difficulties as simply part of life, rather than problems, as they never experienced life without the issues. This mindset seems to have led to an under reporting of health conditions. It is also possible that participants may have felt pressure to acquiesce with their supporters and therefore did not report some health conditions that were unknown to their supporter. There were no reported examples of disagreement between the participants and their supporters. There was no assessment of test-retest reliability. Taking a methodological approach to health assessment is a proxy approach and should, perhaps, be supplemented by medical examinations, to increase validity.

There was also some difficulty in recruiting adequate numbers of INAS athletes and athletes with Down Syndrome. While this could have led to less than ideal power for the linear regressions, significant predictors were nevertheless found. In addition, the correlational nature of the design means that causation cannot be implied from the findings, and variables such as amount of training, socioeconomic background and family attitudes to sport could have confounded the results. That the regression model only predicted 26% of the variance in performance standardised scores indicates that additional factors are playing an important role. Further controlled, longitudinal research would be helpful to addresses these issues.

Future Directions

Further research utilizing medical records or physical examination by medical professionals may be able to provide more certainty about the relationship between impaired intellect and additional physical and sensory disorders and allow for a greater theoretical understanding of the construct of ID itself. Future research with the ID population should not only encompass known disorders, but also focus on natural variability in everyday physical skills, such as balance and manual dexterity. Further exploration into the link between impaired intellect and physical and sensory disorders may have particular significance in explaining the difference in sporting ability between those with and without ID.

In relation to intelligence and sporting ability, whilst evidence is accruing to support the contention that general intelligence and sporting ability are not directly linked, more recent evidence suggests that by taking a more nuanced approach and investigating specific, discrete cognitive skills, links to component skills in specific sports can be found (Burns, 2015).

Conclusion

In conclusion, the results of the current research study provide support for taking a general functional disability approach to developing new **sport** competition classes. **This** would have a positive impact on promoting inclusion and on the development of sports for people with ID. Furthermore, the approach offered by the ICF and that advocated by Tweedy (2002) shows good promise. **The results demonstrating the presence of co-morbidity and the link to IQ i**ndicate that performance is likely to be affected by level of overall disability, including physical and sensory difficulties. Hence, if elite sporting events are to include the full range of people with ID, additional classes could be developed, using the ICF approach to ensure fair competition. **The results from this study provide the first steps in evidencing the possibility of developing a classification system based on a more a more 'unified' approach.**

Table 1

Characteristics of Participants

Group (*n*)	**Sports (*n*)**	**Nationalities (*n*)**	**Gender (*n*)**
INAS athletes (*n*= 28)	Swimming (*n*=19) Tennis (*n*=8) Table tennis (*n*=1)	Italian (*n*=6), Czech (*n*=3), Polish (*n*=4, Spanish (*n*=3), French (*n*=2), Austrian (n=2), Brazilian (*n*=2), Portuguese (*n*=2), Hungarian (*n*=1), Australian (*n*=2) German (*n*=1)	Male (*n* = 21) Female (*n*= 7)
Regional athletes (*n*= 83)	Swimming (*n*=19) Tennis (*n*=23) Athletics (*n*=59) Table tennis (*n*=1) Football (*n*=2) Basketball (*n*=1) Boccia* (*n*=3) Dance (*n*=2)	British (*n*=63), Italian (*n*=5), French (*n*=5), Polish (*n*=3) , Bangladeshi (*n*=3), Australian (*n*=2), Swedish (*n*=1), Indian (*n*=1)	Male (*n*= 60) Female (*n*=22)

* Boccia is a team sport similar to boules as teams aim for their balls to finish as close as possible to a target ball or “jack”. Boccia has been a Paralympic sport since 1984.

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