Relationship between quality of life and physical fitness in adults with intellectual disabilities

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Abstract

Purpose – *People with intellectual disabilities have lower levels of physical fitness compared with peers without intellectual disability, because of the high levels of sedentary behaviour in this population. This study aims to know the relationship between quality of life and physical fitness in adults with intellectual disability.*

Design/methodology/approach – *Ninety-six adults with intellectual disability were assessed with quality of life questionnaire and physical fitness tests, which involve balance, muscle strength, flexibility and aerobic condition.*

Findings – *Adults with higher self-reported levels of quality of life reported higher levels of physical fitness in balance, muscular strength and flexibility. In contrast, in aerobic condition were not found significant correlations with self-reported quality of life.*

Originality/value – *These findings support the hypothesis that people with intellectual disability with lower levels of physical fitness could influence in their levels of quality of life. This insight is useful for improving treatments to improve physical fitness in this population.*

Keywords *Intellectual disabilities, Physical activity, Assessment, Quality of life, Exercise, Physical fitness*

Paper type *Research paper*

1. Introduction

Currently, approximately 1.1% of the world's population are individuals with intellectual disability (Maulik *et al.*, 2011). Lower levels of physical fitness have been found for people with intellectual disability than people without intellectual disability in all stages of the life (Skowronski *et al.*, 2009). As a result, individuals with intellectual disability could experience a loss of independence in daily life activities (Carmeli *et al.*, 2002; Cuesta-Vargas and Pérez-Cruzado, 2014).

This lower level of physical fitness in people with intellectual disability is explained by the fact that this population has low levels of physical activity (Cuesta-Vargas *et al.*, 2011). Physical activity provides an increase in muscular strength, balance, flexibility and aerobic condition (Taylor *et al.*, 2004) and better performance of daily tasks in people with intellectual disabilities (Shields *et al.*, 2013). Consequently, better levels of physical fitness and quality of life in people with intellectual disability who carried out more physical activity were found compared with people with intellectual disability who do not participate in sports activities (Hilgenkamp *et al.*, 2014; Blick *et al.*, 2015).

A number of studies have assessed the quality of life of people with intellectual disability and found good results regarding quality of life (Mirón Canelo *et al.*, 2008); for people with intellectual disability, quality of life levels have been similar to people without intellectual

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disabilities (Couzner *et al.*, 2013). Different studies have shown the relationship between quality of life and physical fitness in different populations of people without intellectual disability (Capozzi *et al.*, 2015) showing a positive relationship between physical fitness (cardiorespiratory fitness and muscular fitness) and quality of life (Bermejo-Cantarero *et al.*, 2021; Ávila-García *et al.*, 2021) in a healthy population. This relationship between both variables has been found in other population, such as severe mental illness, with similar results with positive relationship (Perez-Cruzado *et al.*, 2018). In contrast, no published studies have analysed if this relationship is similar in people with intellectual disability.

The objective of the present study is to know the relationship between quality of life and physical fitness in people with intellectual disabilities. The hypothesis of the present study is similar to that which occurs in people without intellectual disabilities in that significant correlations between quality of life and physical fitness in this population will be found.

2. Material and methods

2.1 Design

An observational cross-sectional study was conducted to assess the relationship between the quality of life and physical fitness (strength, flexibility, balance and aerobic condition) in adults with intellectual disability.

2.2 Participants

The sample included 96 people with mild-moderate intellectual disability (65 men and 31 women) between 18 and 65 years old. The sample was recruited from III National Special Olympics Championships (Madrid, Spain) and an occupational centre (ASPROMANIS INDUSTRIAL, Malaga, Spain).

Inclusion criteria were: people who were capable of reading and writing and people who did not suffer any musculoskeletal or neurological disease that prevented them from performing the physical fitness test. Exclusion criteria were: people with any mental health conditions, people that took medication that could decrease their physical fitness (benzodiazepines, antihistamines, antidepressants and antipsychotics) and people with communication problems associated with their intellectual disability to whom it was impossible to explain the tests.

2.3 Outcomes measure

To measure quality of life, the WHOQoL-DIS scale, because of its recommendation by the World Health Organisation (WHO) for people with disabilities, was used. It has also been used in Spanish people with intellectual disability in previous studies (Lucas-Carrasco *et al.*, 2011) with a range of 0–36 points.

To know the physical fitness of people with intellectual disabilities, 12 physical fitness tests included in the Funfitness screening for intellectual disabilities (FUNfitness (physical therapy), 2020), which cover strength, flexibility, balance and aerobic condition, were used. The 12 tests included:

Passive knee extension (PKE): The participant was positioned supine on a treatment table with hip and knee flexed at 90°. The PKE was measured using a goniometer, with the fulcrum placed over the lateral femoral epicondyle and its arms in the direction of the greater trochanter and lateral malleolus, respectively. Their ankle remained in a neutral position or in plantar flexion. If the knee went fully extended, the final value was recorded as 0°. If the knee did not extend, the value was recorded as negative (e.g. −40°). If the knee went beyond the fully straight position into hyperextension, the value was recorded as positive (e.g. +5°). As proposed by Gajdosik *et al.* (1993), the reliability of the PKE test was explored and compared with other clinical tests for assessing the hamstring muscle (Gajdosik *et al.*, 1993).

Calf muscle flexibility (CMF): The participant was positioned supine on a table, with the hip and knee on the side to be measured in as much extension as possible. The fulcrum of the goniometer was placed over the lateral malleolus, with one of its arms in the direction of the fibular head and the other one parallel to the lateral midline of the fifth metatarsal. Their ankle was passively dorsiflexed and its angle measured while their knee remained in extension. If the participant could not reach neutral position, the angle was recorded as negative (e.g. -10°). If the participant went beyond neutral, it was recorded as positive (e.g. $+10^\circ$). If the participant only reached neutral, it was recorded as 0°. The reliability of this test can be found in Ekstrand *et al.* (1982).

Anterior hip flexibility (AHF): The participant was positioned supine on a table, both hips flexed to 90°. The hip to be measured was flexed up to 100° with a hand beneath the lower back to ensure that it remained flattened. The opposite hip was kept at 90° and not allowed to move into extension during the test. The fulcrum of the goniometer was placed over the greater trochanter, with its arms aligned with the lateral midline of the pelvis and with the lateral midline of the femur, respectively. The degrees of extension between the pelvis and thigh were measured before the pelvis began to move forward. If the thigh lowered to the table surface, the result was recorded as 0°. If the thigh did not reach the table, the angle was recorded as negative (e.g. -25°). The reliability of this test can be found in Ekstrand *et al.* (1982).

Functional shoulder rotation (FSR) (Apley's scratch test): The participant stood or was seated facing the back of a chair. The participant was instructed to reach one arm behind the head and down the back, while the other arm reached behind the hip and up the back. The participant was instructed to "try to touch their index fingers together." A tape measure was used to measure the distance in cm between the index fingers in this position (one arm was in flexion/abduction/lateral rotation; the other was in extension/adduction/medial rotation). The arm on top defined the recorded side (i.e. left arm on top = left; right arm on top = right). If the fingertips touched, the distance was recorded as 0. If the fingertips could not touch, the separation was recorded as negative (e.g. 1.52 cm). If the fingers overlap, the overlap was recorded as positive (e.g. $+2.5$ cm). The FSR is a reproducible measure of upper extremity function task that was validated in people with disabilities. The reliability of this test can be found in Edwards *et al.* (2002).

Timed-stands test (TST): The TST was the method to quantify functional lower extremity muscle strength (hip and knee extension). The test requires the participant to complete ten full stands from a seated position as quickly as possible without the use of their arms. During the test, the participant was seated in a firm straight-backed chair with the elbows flexed to 90°. The participant had to stand ten times as quickly as possible, and the time to perform the task in minutes and seconds was recorded. If the participant could not perform ten repetitions, the number of repetitions and the time taken was recorded. The TST is a reproducible measure of lower extremity function that was validated in people with disabilities. The reliability of this test can be found in Newcomer *et al.* (1993).

Partial sit-up test (PSUT): The PSUT was the method used to quantify abdominal muscle strength/endurance. The test requires the participant to complete as many sit-ups as possible from a supine position in 1 min. The participant was positioned supine on a table or mat, with the legs placed on a chair or stool to keep their hips and knees bent at 90°. Their arms were placed straight out in front of the chest with the elbows extended during the entire test. Test–retest reliability and validity were established in a previous study (Faulkner *et al.*, 1989).

Seated push-up (SPU): The SPU test is a method of assessing the strength of the triceps, shoulder and scapular muscles. The test involves pushing the body up out of a seated position, and slowly lowering it back into the seat. The participant was placed with the knees out straight and the heels resting on the floor or table. The participant had to push their body up from the table or floor until the elbows were straight, held for 20 s and then slowly lowered back into the seat. The reliability of revised push-up test protocol in people without disabilities was 0.80–0.96 (Hong *et al.*, 2011).

Handgrip test (HGT): The HGT is a standardised method for assessing strength of the hand and forearm muscles, as it has been correlated to upper extremity function. The test involved completing three grips on each side (preferred and non-preferred hand) and recording the better of the three trials using an adjustable handgrip dynamometer. The participant had to keep the arm and hand at the side with the elbow bent at 90˚ while squeezing as forcefully as possible. The handgrip dynamometer has been found to be highly reliable [intraclass correlation coefficient (ICC) = 0.98] and valid (ICC = 0.99) for measuring handgrip strength (Bellace *et al.*, 2000).

Single-leg stance with eyes opened (SLSEO): The single-leg stance test with eyes open is designed to assess balance with the assistance of visual cues. The test required the participant to stand on one leg with the eyes open. Balance must be maintained as long as possible. The arms were placed at the sides with elbows slightly flexed during the test. The test continued until the participant lost balance, or put the other foot down (maximum time was 30 s). Interclass correlation coefficients were moderate to excellent (0.41–0.91) (Birmingham, 2000).

Single-leg stance with eyes closed (SLSEC): The single-leg stance test with eyes closed is similar to the previous test but without the assistance of visual cues, thus the participant's eyes are kept closed or covered with a blindfold. Interclass correlation coefficients were moderate to excellent (0.41–0.91) suggesting that standing balance tests are appropriate for distinguishing among group performances (Birmingham, 2000).

Functional reach test (FRT): The test requires the participant to reach forward beyond the length of his/her arm without loss of balance. The participant was on two legs, positioned shoulder width apart (or seated if the participant could not stand). The participant was requested to lift one arm up to 90˚, forward flexion and extend the fingers. Test–retest reliability and validity were established in a previous study (Duncan *et al.*, 1990).

Two-minute step test (2MST) Pre-exercise resting heart rate was recorded with the participant seated before the test and again 2 min after the test was finished (2MAF). The participant was located next to a wall, and the minimum stepping height for the participant was marked. The test required a running tape measure from the iliac crest to the mid-patella, and to mark the midway point on the tape. This mark was transferred to the wall. The participant was requested to march for a maximum of 2 min, bringing each knee alternatively up to the tape mark in the wall. The number of times that the participant touched the tape with the right knee was recorded. The 2MST showed an acceptable reliability (0.63) (Burnstein *et al.*, 2011; Brooks *et al.*, 2002).

2.4 Procedure

First, it was planning a meeting to explain to participants and peers the purpose of the study. In this meeting, the physical fitness test that will be assessed and the scale to measure quality of life were presented. Later, participants who wanted to be evaluated in the study signed the informed consent and they were cited to make the measurements. Three researches measured anthropometric data and quality of life data using the WHOQoL-DIS scale and measured the physical fitness of all participants. Each item of WHOQoL-DIS scale was explained if the participant could not understand or if the item could cause a mistake. On the other hand, physical fitness tests were explained repeatedly and showed via performance to ease the anxiety of the participants. Participants could try to performance the test before the measurement.

2.5 Ethical considerations

Ethical approval was granted by the Ethics Committee of Faculty of Health Science, University of Malaga. In the study, the protection of obtained data of participants in accordance with Organic Law of Data Protection (15/1999) was guaranteed. Informed consent was obtained and informed for all participants in the study.

2.6 Statistical analysis

To carry out a better analysis of data, physical fitness tests were grouped into four categories: strength, flexibility, balance and aerobic condition. Data were grouped into each category following the study of Cuesta-Vargas *et al.* (2013).

To know the homogeneity of the sample, the Kolmogorov–Smirnov test to divide parametric and non-parametric measures was used. The normally distributed data were analysed using the parametric Student's *t*-test and non-normally distributed data were analysed using the non-parametric Wilcoxon's test.

Correlation levels established were as follows: low correlation $r \leq 0.3$; medium correlation $r > 0.3$, $r \leq 0.6$; and high correlation $r > 0.6$ (Portney and Watkins, 2008).

3. Results

The mean age of participants was 34.73 (±11.62). Participants were a mean weight of 72.36 (±16.15) kg and a mean height of 162.02 (±12.52) cm. Mean body mass index was 27.60 (±5.55). The quality of life was 31.07 (±5.22) in the WHOQoL-DIS scale.

Significant correlations were found between quality of life and five physical fitness tests and are presented in Table 1. The most important results were found with balance; specifically, the results with the single-leg stance with open eyes ($r = 0.34$, $p < 0.01$) and with closed eyes ($r = 0.30$, $p < 0.05$) and the FRT ($r = 0.01$, $p < 0.05$). It is important to highlight the correlations found in two of the four strength tests analysed: arm strength (HGT) ($r = 0.24$,

Table 1 Correlations (Pearson's *r*) between measures of quality of life and physical fitness tests

Physical fitness test	*WHOQoL_Total (0–39)*
Balance	
FRT	0.01*
SLSEO	0.34**
SLSEC	0.30*
Flexibility	
PKE	0.04
CMF	0.20
AHF	0.31**
FSR	0.06
Strength	
TST	0.14
PSUT	0.27*
SPU	0.18
HGT	0.24*
Aerobic condition	
2MEST_BE	0.16
2MEST_AE	0.10
2MEST_2MA	0.17

Notes: $*p < 0.05$; $**p < 0.01$

$p < 0.05$) and abdominal strength (PSUT) ($r = 0.27$, $p < 0.05$). A significant correlation between shoulder flexibility and quality of life ($r = 0.31$, $p < 0.01$) was also found. There were not found significant relationship between aerobic condition and quality of life ($r = 0.10–0.17$, $p > 0.05$) and with other strength tests (TST: $r = 0.14$, $p > 0.05$; SPU: $r = 0.18$, $p > 0.05$) and with flexibility tests (PKE: $r = 0.04$, $p > 0.05$; CMF: $r = 0.20$, $p > 0.20$; FSR: $r = 0.06$, $p > 0.05$).

4. Discussion

The aim of the present study was to understand the relationship between quality of life and physical fitness in adults with intellectual disabilities. Our hypothesis was confirmed as significant correlations between balance tests and strength test with quality of life in this population were found. On the other hand, a correlation between aerobic condition and quality of life in adults with intellectual disabilities was not found.

Results regarding the relationship between physical fitness and quality of life in adults with intellectual disabilities have not been previously published. On the contrary, there are studies that have analysed this relationship in other populations without mental retardation (Cuesta-Vargas and Pérez-Cruzado, 2014; Hsu *et al.*, 2014) finding significant relationship between both variables.

The physical condition of people with intellectual disabilities is declined compared to people without disabilities, mainly because of the large number of barriers encountered by this population, such as communication problems, autonomy and social support (Bossink *et al.*, 2017; Borland *et al.*, 2020). This lower physical condition also reduces their independence in activities of daily life, which could be directly related to their quality of life (Cuesta-Vargas and Pérez-Cruzado, 2014).

In the present study, significant correlations between quality of life and the test of static balance single-leg balance test with open eyes ($r = 0.34$) and with closed eyes ($r = 0.30$) and with the semi-static balance FRT ($r = 0.01$) were found. This highlights the fact that the results of the present study are not consistent with previous published studies in people without mental retardation (Olivares *et al.*, 2011). In studies published in people with mental retardation, similar balance tests were used but different results were obtained. In addition, in the study by Olivares *et al.* (2011), the FRT was used. The results showed a negative correlation with quality of life in people without mental retardation ($r = -0.13$) (Olivares *et al.*, 2011). Moreover, in the study by Hsu *et al.* (2014), a unipodal balance test, whose results also showed a negative correlation ($R = -0.10$), was used. The differences between the results here and the results of previous studies in people without mental retardation could be explained by the fact that in the previous studies, the participants were older adults; in contrast, in the present study, the participants were young people with a mean age of 34.73 (±11.62).

Regarding the flexibility test, only significant correlations between hip flexibility and quality of life ($r = 0.31$) were found. In published studies that analysed the relationship between flexibility and quality of life in people without mental retardation, significant correlations with values of $r = 0.10$ (Hsu *et al.*, 2014) using a trunk flexo/extension test were found. In contrast, other studies that used the back scratch test saw correlations that were negative with values of $r = -0.13$ (Olivares *et al.*, 2011). However, in the study by Olivares *et al.*, significant correlations between the back scratch test and one variable of quality of life (anxiety/depression) were not found. This is similar to the present study in which no significant correlations between quality of life and three flexibility tests (CMF/PKE/shoulder rotation) were found. The variability of results from these studies regarding the correlations between flexibility and quality of life could be explained by several factors. First, the studies used as comparisons to the results of the present study were realised in people without mental retardation. Second, the scales to measure quality of life are different in each study and, finally, the flexibility tests (and the parts of the body in which flexibility was measured) varied in each study.

In the present study, significant correlations between quality of life and strength in two physical fitness tests. Significant correlations were found in hand strength (HGT r = 0.24) and in abdominal strength (PSUT r = 0.27). The relationship between hand strength and the quality of life has been shown in a number of studies in people without mental retardation. A study by Sener *et al.* (2013) found significant correlations between hand strength and the SF-36 scale to measure quality of life (r = 0.331). In the study by Hsu *et al.* (2014), correlations between hand strength and quality of life with a value of r = 0.286) were also found. In contrast, in the study by Olivares *et al.* (2011), negative correlations between hand strength and quality of life (r = −0.139) were found. These differing results could be explained by the fact that in the study by Olivares *et al.*, the participants were older adults. It is important to highlight that in the study by Sener *et al.* (2013), significant correlations between leg strength (back-leg strength test) and quality of life (r = 0.331) were found. In contrast, in the present study, the correlations between leg strength and quality of life were not significant, with a value of r = 0.14. This difference between could be because of the fact that in the study by Sener *et al.*, participants were people without mental retardation.

Regarding aerobic condition, in the present study, no significant correlations in any test with quality of life in people with intellectual disabilities were found. The results of the present study are consistent with published studies on people without intellectual disability (Hsu *et al.*, 2014; Chang *et al.*, 2009). It is important to highlight that in the study by Chang *et al.* (2009), the scale used to measure quality of life was the WHOQoL-BREF, in contrast the aerobic condition was measured through VO_{2peak}. Even so, in this study, no significant correlations between the variables, except in 7 of the 26 relationship variables, were found.

On the other hand, is it important to highlight that in the study by Olivares *et al.* (2011), negative significant correlations between aerobic condition assessed with the 6-min walk test and quality of life (r = −0.187) were found. These results are different than the results that were found in the present study.

As a strength of this study, it is important to highlight that this is the first study in which the relationship between physical condition and quality of life in people with intellectual disabilities has been shown, with a battery of 12 physical tests. In contrast, the present study has a series of limitations. Because the sample has not been very large, it has not been possible to divide the sample by gender, level of intellectual disability (mild, moderate or severe), as well as by levels of physical condition. This categorisation of the sample would give us more information about how the quality of life can be related to the physical condition in each of the groups.

The main conclusion of the present study is that in people with mild-moderate intellectual disability, a relationship between quality of life and balance, muscle strength and flexibility exists. In contrast, these relationships were not found in other physical fitness like aerobic condition. The results of the present study should be taken into account by professionals who work in said population to implement physical activity programs in said population. These physical activity programs must be adapted to said population with the objective of improving muscle strength, balance and flexibility of this population.

References

Ávila-García, M., *et al.* (2021), "Relationship between sedentary time, physical activity, and health-related quality of life in Spanish children", *International Journal of Environmental Research and Public Health*, Vol. 18 No. 5, p. 2702, doi: 10.3390/ijerph18052702.

Bellace, J., V, *et al.* (2000), "Validity of the Dexter evaluation system's Jamar dynamometer attachment for assessment of hand grip strength in a normal population", *Journal of Hand Therapy*, Vol. 13 No. 1, pp. 46-51.

Bermejo-Cantarero, A., *et al.* (2021), “Relationship between both cardiorespiratory and muscular fitness and health-related quality of life in children and adolescents: a systematic review and meta-analysis of observational studies”, *Health and Quality of Life Outcomes*, Vol. 19 No. 1, p. 127, doi: 10.1186/s12955-021-01766-0.

Birmingham, T.B. (2000), “Test-retest reliability of lower extremity functional instability measures”, *Clinical Journal of Sport Medicine: official Journal of the Canadian Academy of Sport Medicine*, Vol. 10 No. 4, pp. 264-268.

Blick, R.N., *et al.* (2015), “Effects of declared levels of physical activity on quality of life of individuals with intellectual disabilities”, *Research in Developmental Disabilities*, Vol. 37, pp. 223-229, doi: 10.1016/j.ridd.2014.11.021.

Borland, R.L., *et al.* (2020), “Participation in sport and physical activity in adults with intellectual disabilities”, *Journal of Intellectual Disability Research*, Vol. 64 No. 12, pp. 908-922, doi: 10.1111/jir.12782.

Bossink, L.W.M., van der Putten, A.A. and Vlaskamp, C. (2017), “Understanding low levels of physical activity in people with intellectual disabilities: a systematic review to identify barriers and facilitators”, *Research in Developmental Disabilities*, Vol. 68, pp. 95-110, doi: 10.1016/j.ridd.2017.06.008.

Brooks, D., *et al.* (2002), “Reliability of the two-minute walk test in individuals with transtibial amputation”, *Archives of Physical Medicine and Rehabilitation*, Vol. 83 No. 11, pp. 1562-1565.

Burnstein, B.D., Steele, R.J. and Shrier, I. (2011), “Reliability of fitness tests using methods and time periods common in sport and occupational management”, *Journal of Athletic Training*, Vol. 46 No. 5, pp. 505-513.

Capozzi, L.C., *et al.* (2015), “The impact of physical activity on health-related fitness and quality of life for patients with head and neck cancer: a systematic review”, *British Journal of Sports Medicine*, Vol. 50 No. 6, doi: 10.1136/bjsports-2015-094684.

Carmeli, E., *et al.* (2002), “Muscle power, locomotor performance and flexibility in aging mentally-retarded adults with and without Down’s syndrome”, *Journal of Musculoskeletal & Neuronal Interactions*, Vol. 2 No. 5, pp. 457-462.

Chang, C.-L., *et al.* (2009), “The relationship between quality of life and aerobic fitness in patients with rheumatoid arthritis”, *Clinical Rheumatology*, Vol. 28 No. 6, pp. 685-691, doi: 10.1007/s10067-009-1132-0.

Couzner, L., *et al.* (2013), “Measuring and valuing quality of life for public health research: application of the ICECAP-O capability index in the Australian general population”, *International Journal of Public Health*, Vol. 58 No. 3, pp. 367-376, doi: 10.1007/s00038-012-0407-4.

Cuesta-Vargas, A.I., *et al.* (2013), “A confirmatory factor analysis of the fitness of adults with intellectual disabilities”, *Disability and Rehabilitation*, Vol. 35 No. 5, pp. 375-381, doi: 10.3109/09638288.2012.694961.

Cuesta-Vargas, A.I., Paz-Lourido, B. and Rodriguez, A. (2011), “Physical fitness profile in adults with intellectual disabilities: differences between levels of sport practice”, *Research in Developmental Disabilities*, Vol. 32 No. 2, pp. 788-794, doi: 10.1016/j.ridd.2010.10.023.

Cuesta-Vargas, A.I. and Pérez-Cruzado, D. (2014), “Relationship between Barthel index with physical tests in adults with intellectual disabilities”, *SpringerPlus*, Vol. 3 No. 1, pp. 543, doi: 10.1186/2193-1801-3-543.

Duncan, P., W, *et al.* (1990), “Functional reach: a new clinical measure of balance”, *Journal of Gerontology*, Vol. 45 No. 6, pp. M192-197.

Edwards, T.B., *et al.* (2002), “Interobserver and intraobserver reliability of the measurement of shoulder internal rotation by vertebral level”, *Journal of Shoulder and Elbow Surgery*, Vol. 11 No. 1, pp. 40-42, doi: 10.1067/mse.2002.119853.

Ekstrand, J., *et al.* (1982), “Lower extremity goniometric measurements: a study to determine their reliability”, *Archives of Physical Medicine and Rehabilitation*, Vol. 63 No. 4, pp. 171-175.

Faulkner, R.A., *et al.* (1989), “A partial curl-up protocol for adults based on an analysis of two procedures”, *Canadian Journal of Sport Sciences = Journal Canadien Des Sciences du Sport*, Vol. 14 No. 3, pp. 135-141.

FUNfitness (physical therapy) (2020), Available at: https://resources.specialolympics.org/health/funfitness?locale=en (Accessed: 6 September 2021).

Gajdosik, R.L., *et al.* (1993), "Comparison of four clinical tests for assessing hamstring muscle length", *Journal of Orthopaedic & Sports Physical Therapy*, Vol. 18 No. 5, pp. 614-618, doi: 10.2519/jospt.1993.18.5.614.

Hilgenkamp, T.I.M., van Wijck, R. and Evenhuis, H.M. (2014), "Subgroups associated with lower physical fitness in older adults with ID: results of the HA-ID study", *Research in Developmental Disabilities*, Vol. 35 No. 2, pp. 439-447, doi: 10.1016/j.ridd.2013.11.015.

Hong, J., *et al.* (2011), "Reliability of the sitting hand press-up test for identifying and quantifying the level of scapular medial border posterior displacement in overhead athletes", *International Journal of Sports Physical Therapy*, Vol. 6 No. 4, pp. 306-311.

Hsu, W.-H., *et al.* (2014), "The relationship between health-related fitness and quality of life in postmenopausal women from Southern Taiwan", *Clinical Interventions in Aging*, Vol. 9, pp. 1573-1579, doi: 10.2147/CIA.S66310.

Lucas-Carrasco, R., *et al.* (2011), "Using the WHOQOL-DIS to measure quality of life in persons with physical disabilities caused by neurodegenerative disorders", *Neurodegenerative Diseases*, Vol. 8 No. 4, pp. 178-186, doi: 10.1159/000321582.

Maulik, P.K., *et al.* (2011), "Prevalence of intellectual disability: a meta-analysis of population-based studies", *Research in Developmental Disabilities*, Vol. 32 No. 2, pp. 419-436, doi: 10.1016/j.ridd.2010.12.018.

Mirón Canelo, J.A., *et al.* (2008), "[Health-related quality of life among people with intellectual disabilities in Spain]", *Revista Panamericana de Salud Pública*, Vol. 24 No. 5, pp. 336-344.

Newcomer, K.L., Krug, H.E. and Mahowald, M.L. (1993), "Validity and reliability of the timed-stands test for patients with rheumatoid arthritis and other chronic diseases", *The Journal of Rheumatology*, Vol. 20 No. 1, pp. 21-27.

Olivares, P.R., *et al.* (2011), "Fitness and health-related quality of life dimensions in community-dwelling middle aged and older adults", *Health and Quality of Life Outcomes*, Vol. 9 No. 1, p. 117, doi: 10.1186/1477-7525-9-117.

Perez-Cruzado, D., *et al.* (2018), "The relationship between quality of life and physical fitness in people with severe mental illness", *Health and Quality of Life Outcomes*, Vol. 16 No. 1, p. 82, doi: 10.1186/s12955-018-0909-8.

Portney, L.G. and Watkins, M.P. (2008), *Foundations of Clinical Research: Applications to Practice*, Edición: 0003, Upper Saddle River, N.J., Prentice Hall.

Sener, U., *et al.* (2013), "Evaluation of health-related physical fitness parameters and association analysis with depression, anxiety, and quality of life in patients with fibromyalgia", *International Journal of Rheumatic Diseases*, Vol. 19 No. 8, doi: 10.1111/1756-185X.12237.

Shields, N., *et al.* (2013), "A community-based strength training programme increases muscle strength and physical activity in young people with Down syndrome: a randomised controlled trial", *Research in Developmental Disabilities*, Vol. 34 No. 12, pp. 4385-4394, doi: 10.1016/j.ridd.2013.09.022.

Skowronski, W., *et al.* (2009), "Eurofit special: European fitness battery score variation among individuals with intellectual disabilities", *Adapted Physical Activity Quarterly : APAQ*, Vol. 26 No. 1, pp. 54-67.

Taylor, A.H., *et al.* (2004), "Physical activity and older adults: a review of health benefits and the effectiveness of interventions", *Journal of Sports Sciences*, Vol. 22 No. 8, pp. 703-725, doi: 10.1080/02640410410001712421.

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