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Development of physical fitness test for mild intellectual disabilities aged 13-15 years

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Abstract: This study aims to compile a physical fitness test for mild intellectual disability, test the suitability of the test in terms of suitability, convenience, and safety. The developed tests consist of a bench up and down test, a lying down test, a sitting test and a body mass index test. The stages of development carried out include planning stage, preparation stage, trial, evaluation and revision, and final product. The experimental subjects in this study were children with mild intellectual disabilities aged 13-15 years, totaling 148 people who were divided into limited trial subjects, expanded trial subjects, and validity and reliability test subjects. Validity data analysis technique with two tests using the composite score method and using Doolittle analysis, and reliability data analysis using alpha coefficient analysis. Based on the results of the study, a set of tests was obtained to measure the physical fitness of persons with mild intellectual disabilities with very high validity and reliability tests, where the validity of the test for boys is 0.968 and for girls is 0.914. While the test reliability value for men is 0.896 and for women is 0.883. The physical fitness test was developed according to the characteristics of mild mental retardation which included components on cardiovascular endurance, muscle strength and endurance, flexibility, and body composition.

Keywords: physical fitness, test and measurement, intellectual disability

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INTRODUCTION

Children with low levels of intellectual disability has been found to have a lower physical fitness level compared to normal children of the same age (Chow et al., 2018; de Winter et al., 2016; Golubović et al., 2012; Hsieh et al., 2017; Izquierdo-Gomez et al., 2013; Kyu HAN & Yeon KIM, 2007; Salaun & Berthouze-Aranda, 2012; Slevin et al., 2014; Yanardag et al., 2013). This scoring difference of physical fitness assessment for children with mild intellectual disability is mainly caused by a less-active lifestyle (Einarsson et al., 2016; Finlayson et al., 2009; Hartman et al., 2015; Hinckson & Curtis, 2013; Maïano, 2011; Santos et al., 2014), limited mental ability and short attention span (Vuijk et al., 2010), limitations and barriers in motor development (Hartman et al., 2010; Vuijk et al., 2010; Westendorp et al., 2011), and the lack of motivation to do the best activity during the test (Temple & Walkley, 2007).

Oeseburg (2011) explains the lower degree of fitness affects health problems that are in the child's natural intellectual disabilities includes issues of cardiovascular disease, diabetes mellitus, and poor mental health. Recent studies show that physical fitness especially in child can affect cognitive function (Koch & Hasbrouck, 2013; Kwak et al., 2009; Pontifex et al., 2011; Van Dusen et al., 2011). Furthermore, physical fitness also plays a role in the development of memory and concentration in acquiring (Åberg et al., 2009). With such evidence shows that physical fitness affects the academic achievement of school-age children (Chomitz et al., 2009; Kwak et al., 2009; Van Dusen et al., 2011; Wittberg et al., 2012). Therefore, it is crucial for teachers to know the degree of the physical fitness of the learners in order to determine the suitable physical activity that will be given to the learners and also to maintain the normal body condition during the learning activities in the school or Community activities.

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Skowroński et al (2009) explains that any physical fitness test is influenced by gender (male and female), age and what extend the level of disability of the subject. Research on physical fitness in children and adolescents with intellectual disabilities has been carried out for children and adolescents from mild to moderate intellectual disabilities. However, children and adolescents with a category of severe intellectual disability are not well represented in the previous study (Wouters et al., 2017). The main reason is due to the low cognitive ability of the child with intellectual disability that causes the child to be difficult to understand the instruction or the execution of tests that make the test implementation not to be maximal and then the test result qualifies invalid (Hilgenkamp. et al, 2011). Besides, low motivation in child during a test performance and short attention span also affects the results of the physical fitness test done.

In physical sport, there are some main components of physical fitness which are determined based on two objectives, namely the components of fitness for sports achievements and components of fitness to health. Fitness related to sporting achievements refers to the required component in the competition of each sport. Health-related components refer to the components that are relevant to individual health (Ruiz et al., 2009). Measuring the physical fitness for school children with exclusive conditions for the athlete subjects focuses on the components of fitness health-related where those components include merely body composition, flexibility, strength and muscular endurance, and cardiorespiratory system as well (Katch et al., 2013; Nasrulloh, Apriyanto, et al., 2021).

The composition of the human body can be an early sign of changes in nutritional status that can be done by measuring of anthropometric (Must et al., 2014). Thus, there are some parameters of anthropometry that must be examined before get started. Some of which are your height and weight, body circumference (shape), and thicker folds of the skin. Meanwhile, to measure the body circumference and the thickness of skin folds is calculated using densitometry, a suitable device only carried out in laboratories. While the measurement of height and weight or body mass index with the simplicity of the calculation is the size of anthropometrics mostly often used, either for children or adults (Flegal et al., 2006; Keys et al., 2014). Measuring the body mass index while determining the body composition is performed by measuring height and weight when standing (Arini, 2010).

Dul & Weerdmeester (2003) admits that the flexibility associated with motion of the body is affected by several factors such as the shape of the joints, elasticity of muscles and ligaments, apart from the structure of the bones themselves. Thus, flexibility is a function of the relative ligamentous and/or extensibility of collagen tissues and muscle that pass through the joints. The tension of the ligaments and muscles that limit extensibility is an inhibitor which is much larger for the space motion of the joints. When the tissues do not have elasticity, then its extensibility will decrease. The water content of the cartilaginous discs in some of the joints also affects the mobility of these joints (Vergroesen et al., 2015). Therefore, measuring the suggested body flexibility is likely measuring the sit and reach test. A seated test is a test that aims to measure the flexibility of the back muscles in the forward direction.

Strength and muscular endurance are the ability of muscles to perform or sustain a contraction of the muscles repeatedly in a specific time (Prentice et al., 2012). Yet, it is important to understand the effect of strength training over a period of time to efficiently strengthen the muscular (Earle & Baechle, 2004; Nasrulloh et al., 2022; Noormohammadpour et al., 2012) However, there are some areas on human body where muscle strength can be easily measured, such as the strength of the abdominal muscles. The abdominal muscle groups contribute to increasing intra-abdominal pressure, stabilizing the vertebral column, and defending the posture (Schünke et al., 2012). Furthermore, abdominal muscles are linked to the flexion, torsion, and reflection of the human trunk. Therefore, many fitness measurement methods are recalled to measure the strength and muscle endurance using a group of abdominal muscles otherwise seated bearing tests (Sands & McNeal, 2002). Increasing the maximum strength in body is also an important factor that determines endurance of muscles, if the maximum strength of the abdominal muscles associated with sitting higher, it is assumed that the abdominal muscle endurance is also higher (Noguchi et al., 2013). Cardiorespiratory endurance is one of the most important components in physical fitness which related to health and is a direct indicator of the physiological status of children and adolescents (Cvejić et al., 2013). Yet, cardiorespiratory endurance is a person's ability to perform repetitive motion activities for a long time and is determined by the heart-lung working system to transmit oxygen (O_2) in blood circulation to the muscles (Setiati et al, 2017). Cardiorespiratory endurance improves insulin sensitivity, glucose transport, improve also the function of the nervous system and lower the heart rate. So as to have good cardiorespiratory fitness may decrease

cardiovascular disease such as heart attack, chest pain and stroke (Lee et al., 2010). In general, the field tests are used to measure cardiorespiratory fitness in children intellectual disability in order to do the tests at maximum capacity (Fernhall & Pitetti, 2001). Lotan et al., (2004) have expressed concern that the measure cardiorespiratory fitness by using a field test for the majority of the test instrument has not been validated for children intellectual disability. Since when this concern was disclosed, attempts to validate cardiorespiratory fitness tests for children with intellectual disabilities have been carried out by several researchers (Sutherland et al., 2021; Wouters et al., 2020). Nasuti et al., (2013) stipulates that the Balke Treadmill test (R = 0.93) and step Test (R = 0.95) produce the highest reliability score when compared to Cooper Test (R = 0.81) and Physical Working Capacity Cycle Ergometry Test (R = 0.64).

We all know that physical fitness during childhood has been identified as a strong predictor of current and future of health status (Naidoo & Coopoo, 2012; Ruiz et al., 2009; Smith et al., 2014). Therefore, the pre-existing raw physical fitness test starts from the category of 6-year age. The division of categorization is based on the motor development of children and adolescents. As for children of mild intellectual disabilities, motor development at the age of 6 years is similar to normal motor child development at age 2 where they have just learned to run, balancing the body, and can only engage in activities that requires direction (Columna, 2016). Therefore in this study, researchers developed physical fitness test for mild intellectual disability children age 13-15 years old due to the age of its motoristic development is the same as normal children aged 6-8 years where they can participate in modified sporting activities (Columna, 2016).

METHODS

This research was conducted using the method of reseach and development (R & D). This research was conducted within September to November 2019. Subjects who partook in this study are determined by sampling nonprobability with purposive technique. Consideration used as a sample of this research is mild intellectual disability aged 13-15 years, men and women who did not have dual disorders (double abnormalities). Based on this, the 148 study subjects with mild intellectual disability aged 13-15 years were purposely chosen. This research was conducted with several stages: 1) the planning phase which includes the study of literature and preliminary investigation or preliminary analysis, (2) preparation of which includes the preparation of the test (determining the test items and establishing the test procedure), expert validation and revision, (3) trial stages including limited trials, expanded trials, drafting norms, determining validity, and reliability of tests, and 4) final products which produced by the validity and reliability of instrument test resulting in physical fitness for mild intellectual disability ages 13-15 children.

Data in this study included test feasibility and assessment data, content validity data, empirical validity data, reliability of data, and test assessment data. The instruments and techniques for collecting data used were questionnaires that used to examine the feasibility of the test, content validity test, and test feasibility. Validity of empirical testing was done twice, the first validity was to validate the test items and the second validity test was the combined validity test, because of physical fitness test for intellectual disability ages 13-15 years wass the reliability data test battery which is done with test-retest. To analyze the data of the validity content test is used by the analysis of Aiken's V. Analyzing the assessment data of the feasibility test obtained from a physical education teacher and handicap expert were done by using the method of questionnaire/poll with Guttman scale. The validity of the test questions is analyzed by correlating the score of test questions with the total score, this method is often referred to as the composite score method. The analysis of the validity of the battery test was used by Doolittle's statistical analysis. The reliability analysis of the test questions is measured from the coefficient correlation between the first try and second try. When the correlation is positive and significant, it meant that the instrument has been declared reliable. While the test battery reliability analysis was done by using the coefficient alpha

RESULTS AND DISCUSSION

Analysis of the content of the draft validation of the physical fitness test for mild intellectual disabilities children 13-15 years of old which conducted by four experts (See Table 1).

Table 1. Results of Preliminary Draft Validation Analysis

No	Aspect	Aiken's V	Information
1.	Test Item	0.94	Almost Perfect Agreement
2.	Test procedure	0.91	Almost Perfect Agreement
3.	Test Equipment	0.97	Almost Perfect Agreement
4.	Assessment Tests	0.94	Almost Perfect Agreement

The draft validation assessment shows that the whole aspect was categorized in the almost perfect agreement which means all expert judjement has the same agreement that the draft of the physical fitness test products for mild intellectual disability aged 13-15 years is appropriate or has very good content validity. It can also be explained that the draft of physical fitness test for mild intellectual disabilities aged 13-15 children can also be tested on the field.

The trial field was done twice: limited trials and expanded trials. Limited trials were conducted to determine the feasibility of the product when applied to the field. While expended trials were conducted to find out the categorization of the test items, test norms, empirical validity, and reliability of the test.

Table 2. Feasibility Tests Result

Aspect	Appraisal		Final Rating	Criteria
	Teacher	Expert		
Conformity	100%	100%	100%	Very High
Easiness	88.89%	100%	94.45%	Very High
Security	100%	100%	100%	Very High

Based on the final assessment of the limited trials (Table 2) showed a total conformity aspect value of 100%, the total aspect value of the facility is 94.45%, and the total value of the aspect of the security is 100%. This shows that the results of the final assessment of intellectual disability and the products of physical fitness test in limited trials have a very high eligibility criteria for aspects of conformity, simplicity and security. These results serve as guidelines for researchers to conduct an expanded trial. An expanded trial was first conducted to find out the items categorization test and norms of physical fitness test for mild intellectual disability age 13-15 years children.

Many studies have shown that there is a prevalence of obesity for children's intellectual disabilities (Hutzler & Korsensky, 2010; Melville et al., 2011; Shields et al., 2009). However, the prevalence of obesity experienced by children with intellectual disability due to the less-active lifestyle (Finlayson et al., 2009; Santos et al., 2014), not because of the principle aspect of disability. Therefore, in determining the value category of body mass index of researcher is guided by the norms of the BMI assessment norm based on age by the Ministry of Health of the Republic of Indonesia (Kemenkes, 2020). To measuring the category of assessment of body mass index within physical fitness test for a light intellectual disability aged 13-15 years is displayed in Table 3.

Table 3. Category Value of Body Mass Index

Men Index		Category Value		Women Index
≤ 13.8	1	Malnutrition	1	≤ 13.8
13.8-14.8	2	Very Thin	2	13.6-14.8
14.9-16.3	3	Thin	3	14.9-16.5
16.4-18.1	4	Ideal Low	4	16.6-18.7
18.2-20.7	5	Ideal	5	18.8-21.7
20.8-24.7	4	Ideal High	4	21.8-26.1
24.8-31.6	3	Fat	3	26.2-33.3
31.7-34.7	2	Very fat	2	33.4-36.0
≥ 34.7	1	Obesity	1	≥ 36.0

Source: (Kemenkes, 2020)

Furthermore, to determine the categorization of the test items sit grab, baring sit, and test up down bench is done with the following steps: a) looking for the range (highest score minus the lowest score), b) determine the categorization of assessment in form 5 categorization, c) seek classes interval, and d) creating a value category with baseline calculation interval. The categorization of the seated test is achieved, the baring test sits, and the bullish test bench is presented on Table 4-6.

Table 4. Sitting Categorization Test Scores obtained

Category Value		Result	
		Male	Female
Very good	5	≥ 35	≥ 30
Well	4	27-34	23-29
Enough	3	19-26	16 -22
Low	2	11-18	9-15
Very low	1	3-10	2-8

Table 5. Sitting Baring Categorization Test Scores

Category Value		Result	
		Male	Female
Very good	5	≥ 37	≥ 30
Well	4	29-36	23-29
Enough	3	21-28	16 -22
Less	2	12-20	9-15
Very less	1	4-11	2 -8

Table 6. Categorization Values Up Down Test Bench

Category Value		Result	
		Male	Female
Very good	5	≥ 97	≥ 95
Well	4	84-96	81-94
Enough	3	71-83	67 -80
Less	2	58-70	53-66
Very less	1	45-57	39-52

Once the assessment categorization is determined, then the next step is to determine the norm of assessment. Norms battery assessment of physical fitness test for mild intellectual disability age of 13-15 years are presented in the following Table 7.

Table 7. Norm Ratings

No	Total Value	Classification
1	16-20	Very Good (VG)
2	12-15	Good (G)
3	9-11	Moderate (M)
4	5-8	Low (L)
5	1-4	Very low (VL)

The interpretation of the table above is described: if a child with intellectual disability is light (mild) aged 13-15 years of physical fitness test, then obtained the results of the measurement of the body index with the index of 16.4, then the child is in the category of "ideal low" and get a value of 4. The result of seated test measurements achieved with a distance of 19 centimeters, then enter the category "Enough" and get a value of 3. The baring test results sit for 60 seconds as much as 37 times the repetition of motion, so enter in the category "very good" and get a value of 5. The test results for up and down on the bench with the pulse calculation on the radial artery of 84, so it falls into the category of "good" and gets a value of 4. So the total value that the child gets in carrying out a physical fitness test of 16 and fall into the category of "very good". This means that the child has a very good physical fitness and can also be indicated that the child has a very good health.

After determining the categorization and norms of research, the next step is to look for the validity value of the test items, the validity of the test battery, the reliability of the test items, and the reliability of the battery tests are presented in Table 8-11.

Table 8. Score of Validity Test Item

Test Item	Validity		Criteria
Body mass Indeks	Male	0.654	High
	Female	0.642	High
Seated Fitness Test	Male	0.936	Very High
	Female	0.919	Very High
Each test Baring	Male	0.882	Very High
	Female	0.884	Very High
Down Up Test Bench	Male	0.876	Very High
	Female	0.849	Very High

Table 9. Value of Validity Test Battery

Variables		Validity	Criteria
Physical Fitness Test Mild Intellectual	Male	0.968	Very High
Disability Age 13-15 Years	Female	0.914	Very High

Table 10. Value of Item Reliability Tests

Test Item	Reliability		Criteria
Body Mass Index	Male	0.994	Very High
	Female	0.991	Very High
Achieve Fitness Test	Male	0.952	Very High
	Female	0.945	Very High
Each Test Baring	Male	0,862	Very High
	Female	0.841	Very High
Down Up Test Bench	Male	0.892	Very High
	Female	0.895	Very High

Table 11. Value of Reliability Battery Test

Variables		Reliability	Criteria
Physical Fitness Test Mild Intellectual	Male	0.896	Very High
Disability Age 13-15 Years	Female	0.883	Very High

Based on Table 8-11, these showed that the product of physical fitness test for mild intellectual disabilities aged 13-15 have a very high validity value. The results indicate that physical fitness test with mild intellectual disability aged 13-15 years have the precision and accuracy to measure the components of physical fitness. This means that the test results of the measurements show the result of the real state of what is measured, so it can be used to determine the degree of physical fitness for mild intellectual disability age 13-15 years. Furthermore, for children with mild intellectual disability and physical fitness test aged 13-15 years have also a very high reliability values. The results indicated that the test of physical fitness for mild intellectual disability aged 13-15 years have a very high consistency in measuring the physical fitness of a mild intellectual disability aged 13-15 years.

Physical fitness test for mild intellectual disability in this study has been analyzed by four experts (physical fitness expert, test and measurement expert, mild intellectual disability expert, and probability expert) through draft validation, observed the implementation of the test through limited trials and expanded trials have been declared very good. These results are in line with the research by Handayani & Kartiko (2021) that stone painting media is stated to be very good for use by students with disabilities as evidenced by the value of the percentage of media display aspects and aspects of media utilization giving very good results with validation results of more than 60%.

After the assessment process by experts (product validation), Adaptive Physical Education Teachers and Intellectual Disabilities Experts (limited trials and expanded trials), a revision process was carried out on the development draft. Finally produced a physical fitness test kit for mild intellectual disabilities aged 13-15 years. This final product has been included in a test implementation guide book. The manual is in the form of a test manual containing test items for fitness, validity and reliability of

test items and test batteries, general instructions, objectives for measuring test items, tools and facilities needed to carry out tests, implementation procedures, assessment procedures, and procedures for determining outcome criteria. test. Nurdiantimala, Widyarthara & Pramitasari (2021) stated that the fitness facilities provided were still not friendly for users with disabilities, so development was needed to meet activity needs. For this reason, the final product of the physical fitness test for mild intellectual disability aged 13-15 years was developed to suit their needs.

This development research aims to produce a test that can be used to measure the degree of physical fitness of mild intellectual disabilities aged 13-15 years. The product preparation process is based on an analysis of the literature review conducted by researchers on the physical fitness component that is integrated with the characteristics of children with mild intellectual disabilities aged 13-15 years. The resulting draft based on the analysis of the literature review was then validated by expert judgment to obtain suggestions and input on the product prepared by the researcher. These expert suggestions and inputs are used to revise the developed draft to suit the development objectives. After the draft was revised and validated by expert judgment, then a limited trial was conducted to determine the effectiveness of the implementation in the field. Based on the results of research that the most influential on physical fitness is fat adequacy (Indraswari et al., 2022).

Limited trials were conducted to obtain assessments, suggestions and input from Adaptive Physical Education Teachers as potential users of the product, and Experts with Intellectual Disabilities in Special Schools. The assessment includes aspects of suitability, convenience, and safety of the test items, tools and facilities used, implementation procedures, and physical fitness test assessment procedures for mild intellectual disabilities aged 13-15 years. After the researchers revised the draft in accordance with the assessments, suggestions, and input from the Adaptive Physical Education Teachers and Intellectual Disabilities Experts on the physical fitness test for mild intellectual disabilities aged 13-15 years, a second trial was conducted, namely an expanded trial. The expanded trial was carried out with more experimental subjects than the limited trial to make assessment classifications and norms for assessing physical fitness with mild intellectual disability. The preparation of assessment classifications and assessment norms is based on physical fitness measurement data for mild intellectual disabilities aged 13-15 years. The classification of physical fitness assessments and norms of various test items carried out is in line with research by Rismayanthi et al (2022) which shows that all components of physical fitness, including aerobic endurance, upper and lower body strength, upper and lower body flexibility, and balance, increased significantly in subjects ($p < 0.05$). Based on the results said that the significant effect of aerobic training with skipping on cardiorespiratory endurance. (Nasrulloh, Yuniana, et al., 2021). The results showed that aerobic exercise had a positive impact on increasing physical fitness.

After the assessment classification and assessment norms are arranged, the next step is to look for the validity of the test items, the validity of the test batteries, the reliability of the test items and the reliability of the test batteries. The validity and reliability of the test were obtained from trial data with trial subjects with the same characteristics but not included in the test subjects during limited trials and expanded trials. Finally, a physical fitness test for mild intellectual disability aged 13-15 years has validity and reliability, so that the physical fitness test product for mild intellectual disability aged 13-15 years can be used to measure the degree of physical fitness with mild intellectual disability aged 13-15 years. contained in the manual, there are test items tested, necessary tools and facilities, test implementation procedures, test assessment procedures, how to conduct assessments, interpretation of assessment results into assessment norms, and assessment forms.

CONCLUSIONS

The results of field test assessment showed that physical fitness tests are developed in accordance with the characteristics of mild intellectual disabilities. This test is safe to implement and easily understood by children with mild intellectual disabilities aged 13-15 years, so that they can carry out tests properly. The criteria of the developed fitness test resulted in the validity and reliability of the test, where the validity of the physical fitness test and with mild intellectual disability age 13-15 years fall in a very high criteria, which amounted to 0.968 for males and 0.914 for the females. In addition to the reliability value of physical fitness tests and mild intellectual disability age 13-15 years are also in the very high criteria of the amount of 0.896 for men's tests and 0.883 for the women's tests.

REFERENCES

Åberg, M. A. I., Pedersen, N. L., Torén, K., Svartengren, M., Bäckstrand, B., Johnsson, T., Cooper-Kuhn, C. M., Åberg, N. D., Nilsson, M., & Kuhn, H. G. (2009). Cardiovascular fitness is associated with cognition in young adulthood. *Proceedings of the National Academy of Sciences of the United States of America*, *106*(49). https://doi.org/10.1073/pnas.0905307106

Arini, F. A. (2010). Pengukuran antropometri dan hubungannya dengan"golden standard"persen lemak tubuh, bioelectrical impedance analysis: studi validasi pada anak sekolah dasar tahun 2010. *Fkm Ui*, 1–101.

Chomitz, V. R., Slining, M. M., McGowan, R. J., Mitchell, S. E., Dawson, G. F., & Hacker, K. A. (2009). Is there a relationship between physical fitness and academic achievement? Positive results from public school children in the Northeastern United States. *Journal of School Health*, *79*(1). https://doi.org/10.1111/j.1746-1561.2008.00371.x

Chow, B. C., Choi, P. H. N., & Huang, W. Y. J. (2018). Physical activity and physical fitness of adults with intellectual disabilities in group homes in Hong Kong. *International Journal of Environmental Research and Public Health*, *15*(7). https://doi.org/10.3390/ijerph15071370

Columna, L. (2016). Principles and Methods of Adapted Physical Education and Recreation (11th Edition). *Adapted Physical Activity Quarterly*, *27*(1). https://doi.org/10.1123/apaq.27.1.73

Cvejić, D., Pejović, T., & Ostojić, S. (2013). Assessment of physical fitness in children and adolescents. *Facta Universitatis - Series: Physical Education and Sport*, *11*(2).

de Winter, C. F., van den Berge, A. P. J., Schoufour, J. D., Oppewal, A., & Evenhuis, H. M. (2016). A 3-year follow-up study on cardiovascular disease and mortality in older people with intellectual disabilities. *Research in Developmental Disabilities*, *53–54*. https://doi.org/10.1016/j.ridd.2016.01.020

Dul, J., & Weerdmeester, B. (2003). Ergonomics For Beginners. In *Ergonomics For Beginners*. https://doi.org/10.4324/9780203212097

Earle, R., & Baechle, T. R. (2004). The NSCA's essentials of personal training text. In *Strength and Conditioning Journal* (Vol. 26, Issue 2). https://doi.org/10.1519/00126548-200404000-00015

Einarsson, I. T., Jóhannsson, E., Daly, D., & Arngrímsson, S. Á. (2016). Physical activity during school and after school among youth with and without intellectual disability. *Research in Developmental Disabilities*, *56*. https://doi.org/10.1016/j.ridd.2016.05.016

Fernhall, B., & Pitetti, K. (2001). Limitations to physical work capacity in individuals with mental retardation. *Clinical Exercise Physiology*, *3*(4).

Finlayson, J., Jackson, A., Cooper, S. A., Morrison, J., Melville, C., Smiley, E., Allan, L., & Mantry, D. (2009). Understanding predictors of low physical activity in adults with intellectual disabilities. *Journal of Applied Research in Intellectual Disabilities*, *22*(3). https://doi.org/10.1111/j.1468-3148.2008.00433.x

Flegal, K. M., Tabak, C. J., & Ogden, C. L. (2006). Overweight in children: Definitions and interpretation. *Health Education Research*, *21*(6). https://doi.org/10.1093/her/cyl128

Golubović, Š., Maksimović, J., Golubović, B., & Glumbić, N. (2012). Effects of exercise on physical fitness in children with intellectual disability. *Research in Developmental Disabilities*, *33*(2). https://doi.org/10.1016/j.ridd.2011.11.003

Handayani, D. T., & Kartiko, D. C. (2021). Evaluasi Pengembangan Media Painting Stone Pada Siswa Disabilitas Netra. *Jurnal Pendidikan Olahraga Dan Kesehatan Volume*, *09*(01).

Hartman, E., Houwen, S., Scherder, E., & Visscher, C. (2010). On the relationship between motor performance and executive functioning in children with intellectual disabilities. *Journal of Intellectual Disability Research*, *54*(5). https://doi.org/10.1111/j.1365-2788.2010.01284.x

Hartman, E., Smith, J., Westendorp, M., & Visscher, C. (2015). Development of physical fitness in children with intellectual disabilities. *Journal of Intellectual Disability Research*, *59*(5). https://doi.org/10.1111/jir.12142

Hinckson, E. A., & Curtis, A. (2013). Measuring physical activity in children and youth living with intellectual disabilities: A systematic review. In *Research in Developmental Disabilities* (Vol. 34, Issue 1). https://doi.org/10.1016/j.ridd.2012.07.022

Hsieh, K., Hilgenkamp, T. I. M., Murthy, S., Heller, T., & Rimmer, J. H. (2017). Low levels of physical activity and sedentary behavior in adults with intellectual disabilities. *International Journal of Environmental Research and Public Health*, *14*(12). https://doi.org/10.3390/ijerph14121503

Hutzler, Y., & Korsensky, O. (2010). Motivational correlates of physical activity in persons with an intellectual disability: A systematic literature review. In *Journal of Intellectual Disability Research* (Vol. 54, Issue 9). https://doi.org/10.1111/j.1365-2788.2010.01313.x

Indraswari, S. H., Rahfiludin, M. Z., & Rosidi, A. (2022). Correlation between nutritional adequacy, Fe content, body fat percentage, and muscle mass percentage with physical fitness. *Jurnal Keolahragaan*, *10*(1), 21–30. https://doi.org/10.21831/jk.v10i1.46001

Izquierdo-Gomez, R., Martínez-Gómez, D., Tejero-Gonzalez, C. M., Cabanas-Sánchez, V., Ruiz Ruiz, J., & Veiga, Ó. L. (2013). Are poor physical fitness and obesity two features of the adolescent with Down syndrome? *Nutrición Hospitalaria*, *28*(4). https://doi.org/10.3305/nh.2013.28.4.6566

Katch, V. L., McArdle, W. D., & Katch, F. I. (2013). Essentials of exercise physiology: Fourth edition. In *Essentials of Exercise Physiology: Fourth Edition*.

Kemenkes. (2020). Standar Antropometri Anak. *Engineering, Construction and Architectural Management*, *25*(1).

Keys, A., Fidanza, F., Karvonen, M. J., Kimura, N., & Taylor, H. L. (2014). Indices of relative weight and obesity. *International Journal of Epidemiology*, *43*(3). https://doi.org/10.1093/ije/dyu058

Koch, C., & Hasbrouck, L. (2013). Exploring the Link between Physical Activity , Fitness and Cognitive Function. *Illinois Enhance PE Task Force*.

Kwak, L., Kremers, S. P. J., Bergman, P., Ruiz, J. R., Rizzo, N. S., & Sjöström, M. (2009). Associations between physical activity, fitness, and academic achievement. *Journal of Pediatrics*, *155*(6). https://doi.org/10.1016/j.jpeds.2009.06.019

Kyu HAN, M., & Yeon KIM, D. (2007). *Development of Assessment Standards for Health-Related Physical Fitness in Persons with Intellectual Disability*. *1995*.

Lee, D. chul, Artero, E. G., Sui, X., & Blair, S. N. (2010). Mortality trends in the general population: the importance of cardiorespiratory fitness. In *Journal of psychopharmacology (Oxford, England)* (Vol. 24, Issue 4 Suppl). https://doi.org/10.1177/1359786810382057

Lotan, M., Isakov, E., Kessel, S., & Merrick, J. (2004). Physical fitness and functional ability of children with intellectual disability: effects of a short-term daily treadmill intervention. *The Scientific World Journal*, *4*. https://doi.org/10.1100/tsw.2004.97

Maïano, C. (2011). Prevalence and risk factors of overweight and obesity among children and adolescents with intellectual disabilities. *Obesity Reviews*, *12*(3). https://doi.org/10.1111/j.1467-789X.2010.00744.x

Melville, C. A., Boyle, S., Miller, S., MacMillan, S., Penpraze, V., Pert, C., Spanos, D., Matthews, L., Robinson, N., Murray, H., & Hankey, C. R. (2011). An open study of the effectiveness of a multi-component weight-loss intervention for adults with intellectual disabilities and obesity. *British Journal of Nutrition*, *105*(10). https://doi.org/10.1017/S0007114510005362

Must, A., Curtin, C., Hubbard, K., Sikich, L., Bedford, J., & Bandini, L. (2014). Obesity Prevention for Children with Developmental Disabilities. *Current Obesity Reports*, *3*(2). https://doi.org/10.1007/s13679-014-0098-7

Naidoo, R., & Coopoo, Y. (2012). The impact of a primary school physical activity intervention in KwaZulu-Natal, South Africa : health and physical activity. *African Journal for Physical Health Education, Recreation*(18).

Nasrulloh, A., Apriyanto, K. D., & Prasetyo, Y. (2021). *Pengukuran dan Metode Latihan Kebugaran* (1st ed.). UNY Press.

Nasrulloh, A., Prasetyo, Y., Nugroho, S., Yuniana, R., & Wahyudin Pratama, K. (2022). The effect of weight training with compound set method on strength and endurance among archery athletes. *Journal of Physical Education and Sport ® (JPES)*, *22*(6), 1457–1463. https://doi.org/10.7752/jpes.2022.06183

Nasrulloh, A., Yuniana, R., & Pratama, K. W. (2021). The effect of skipping combination with body weight training on cardiorespiratory endurance and body mass index (BMI) as a covid-19 prevention effort for overweight adolescents. *Jurnal Keolahragaan*, *9*(2), 220–230. https://journal.uny.ac.id/index.php/jolahraga/article/view/41678

Nasuti, G., Stuart-Hill, L., & Temple, V. A. (2013). The Six-Minute Walk Test for adults with intellectual disability: A study of validity and reliability. *Journal of Intellectual and Developmental Disability*, *38*(1). https://doi.org/10.3109/13668250.2012.748885

Noguchi, T., Demura, S., & Takahashi, K. (2013). Relationships between Sit-Ups and Abdominal Flexion Strength Tests and the Thickness of Each Abdominal Muscle. *Advances in Physical Education*, *03*(02). https://doi.org/10.4236/ape.2013.32014

Noormohammadpour, P., Kordi, R., Dehghani, S., & Rostami, M. (2012). The effect of abdominal resistance training and energy restricted diet on lateral abdominal muscles thickness of overweight and obese women. *Journal of Bodywork and Movement Therapies*, *16*(3). https://doi.org/10.1016/j.jbmt.2011.12.001

Pontifex, E. K., Gerlag, D. M., Gogarty, M., Vinkenoog, M., Gibbs, A., Burgman, I., Fearon, U., Bresnihan, B., Tak, P. P., Gibney, R. G., Veale, D. J., & FitzGerald, O. (2011). Change in CD3 positive T-cell expression in psoriatic arthritis synovium correlates with change in DAS28 and magnetic resonance imaging synovitis scores following initiation of biologic therapy - a single centre, open-label study. *Arthritis Research and Therapy*, *13*(1). https://doi.org/10.1186/ar3228

Prentice, J. C., Graeme Fincke, B., Miller, D. R., & Pizer, S. D. (2012). Primary care and health outcomes among older patients with diabetes. *Health Services Research*, *47*(1 PART 1). https://doi.org/10.1111/j.1475-6773.2011.01307.x

Rismayanthi, C., Zein, M. I., Mulyawan, R., Nurfadhila, R., Prasetyawan, R. R., & Antoni, M. S. (2022). The effect of low impact aerobic exercise on increasing physical fitness for the elderly. *Jurnal Keolahragaan*, *10*(1), 137–146. https://doi.org/10.21831/jk.v10i1.48743

Ruiz, J. R., Gómez-Gallego, F., Santiago, C., González-Freire, M., Verde, Z., Foster, C., & Lucia, A. (2009). Is there an optimum endurance polygenic profile? *Journal of Physiology*, *587*(7). https://doi.org/10.1113/jphysiol.2008.166645

Salaun, L., & Berthouze-Aranda, S. E. (2012). Physical Fitness and Fatness in Adolescents with Intellectual Disabilities. *Journal of Applied Research in Intellectual Disabilities*, *25*(3). https://doi.org/10.1111/j.1468-3148.2012.00659.x

Sands, W. A., & McNeal, J. R. (2002). A kinematic comparison of four abdominal training devices and a traditional abdominal crunch. *Journal of Strength and Conditioning Research*, *16* (1). https://doi.org/10.1519/1533-4287

Santos, R., Mota, J., Okely, A. D., Pratt, M., Moreira, C., Coelho-E-Silva, M. J., Vale, S., & Sardinha, L. B. (2014). The independent associations of sedentary behaviour and physical activity on cardiorespiratory fitness. *British Journal of Sports Medicine*, *48*(20). https://doi.org/10.1136/bjsports-2012-091610

Schünke, M., Schulte, E., Schumacher, U., Voll, M., & Wesker, K. (2012). Prometheus Lernatlas der Anatomie - Innere Organe. *Prometheus Lernatlas Der Anatomie - Innere Organe*.

Setiati, Siti; Alwi, Idrus; Sudoyono, Aru. W; K. Simadibrata, Marcellus; Setiyohadi, Bambang; Syam Ari, F. (2017). Buku Ajar Ilmu Penyakit Dalam Jilid I. In *Ilmu Penyakit Dalam*.

Shields, N., Dodd, K. J., & Abblitt, C. (2009). Do children with down syndrome perform sufficient physical activity to maintain good health? A pilot study. *Adapted Physical Activity Quarterly*, *26*(4). https://doi.org/10.1123/apaq.26.4.307

Skowroński, W., Horvat, M., Nocera, J., Roswal, G., & Croce, R. (2009). Eurofit Special: European fitness battery score variation among individuals with intellectual disabilities. *Adapted Physical Activity Quarterly*, *26*(1). https://doi.org/10.1123/apaq.26.1.54

Slevin, E., Truesdale-Kennedy, M., Mcconkey, R., Livingstone, B., & Fleming, P. (2014). Obesity and overweight in intellectual and non-intellectually disabled children. *Journal of Intellectual Disability Research*, *58*(3). https://doi.org/10.1111/j.1365-2788.2012.01615.x

Smith, J. J., Eather, N., Morgan, P. J., Plotnikoff, R. C., Faigenbaum, A. D., & Lubans, D. R. (2014). The health benefits of muscular fitness for children and adolescents: A systematic review and meta-analysis. In *Sports Medicine* (Vol. 44, Issue 9). https://doi.org/10.1007/s40279-014-0196-4

Sugiyono. (2021). Sugiyono, Metode Penelitian Pendidikan; Pendekatan Kuantitatif dan R&D. *Jurnal Al-Hikmah*, *1*(1).

Sutherland, L., McGarty, A. M., Melville, C. A., & Hughes-McCormack, L. A. (2021). Correlates of physical activity in children and adolescents with intellectual disabilities: a systematic review. In *Journal of Intellectual Disability Research* (Vol. 65, Issue 5). https://doi.org/10.1111/jir.12811

T., H., R., V. W., & H., E. (2011). Physical activity in older adults with intellectual disabilities. *European Geriatric Medicine*, *2*.

Temple, V. A., & Walkley, J. W. (2007). Perspectives of constraining and enabling factors for health-promoting physical activity by adults with intellectual disability. *Journal of Intellectual and Developmental Disability*, *32* (1). https://doi.org/10.1080/13668250701194034

Van Dusen, D. P., Kelder, S. H., Kohl, H. W., Ranjit, N., & Perry, C. L. (2011). Associations of Physical Fitness and Academic Performance Among Schoolchildren. *Journal of School Health*, *81*(12). https://doi.org/10.1111/j.1746-1561.2011.00652.x

Vergroesen, P. P. A., Kingma, I., Emanuel, K. S., Hoogendoorn, R. J. W., Welting, T. J., van Royen, B. J., van Dieën, J. H., & Smit, T. H. (2015). Mechanics and biology in intervertebral disc degeneration: A vicious circle. In *Osteoarthritis and Cartilage* (Vol. 23, Issue 7). https://doi.org/10.1016/j.joca.2015.03.028

Vuijk, P. J., Hartman, E., Scherder, E., & Visscher, C. (2010). Motor performance of children with mild intellectual disability and borderline intellectual functioning. *Journal of Intellectual Disability Research*, *54*(11). https://doi.org/10.1111/j.1365-2788.2010.01318.x

Westendorp, M., Houwen, S., Hartman, E., & Visscher, C. (2011). Are gross motor skills and sports participation related in children with intellectual disabilities? *Research in Developmental Disabilities*, *32*(3). https://doi.org/10.1016/j.ridd.2011.01.009

Whalen, S. J. (2013). Cyberathletes' Lived Experience of Video Game Tournaments. *Phd Diss.,University Of Tennessee , 2013*.

Wittberg, R. A., Northrup, K. L., & Cottrell, L. A. (2012). Children's aerobic fitness and academic achievement: A longitudinal examination of students during their fifth and seventh grade years. *American Journal of Public Health*, *102*(12). https://doi.org/10.2105/AJPH.2011.300515

Wouters, M., Evenhuis, H. M., & Hilgenkamp, T. I. M. (2017). Systematic review of field-based physical fitness tests for children and adolescents with intellectual disabilities. In *Research in Developmental Disabilities* (Vol. 61). https://doi.org/10.1016/j.ridd.2016.12.016

Wouters, M., Evenhuis, H. M., & Hilgenkamp, T. I. M. (2020). Physical fitness of children and adolescents with moderate to severe intellectual disabilities. *Disability and Rehabilitation*, *42*(18). https://doi.org/10.1080/09638288.2019.1573932

Yanardag, M., Arikan, H., Yilmaz, I., & Konukman, F. (2013). Physical fitness levels of young adults with and without intellectual disability. *Kinesiology*, *45*(2).