

COMPARATIVE ANALYSIS OF ARM MUSCLE STRENGTH BASED ON GENDER IN STUDENTS AGED 10-12 YEARS AT ELEMENTARY SCHOOL MUHAMMADIYAH 08, DAU DISTRICT, MALANG REGENCY

Atika Yulianti¹, Fajar Abhyasa Abimanyu^{2*}, Nungki Marlian Yuliadarwati³
Universitas Muhammadiyah Malang, Indonesia
fajarbima404@gmail.com

ABSTRACT

Every child experiences development; development occurs from an early age to adulthood. Development is progressive, systematic and sustainable. The things that develop in every child are the same; it is just that there are differences, differences in the speed of development, and there is a development that precedes the previous development, even though the development between one aspect and another occurs in tandem. This study aims to analyze the factors that affect the strength of arm muscles in students aged 10-12 years. This quantitative study uses an observational analytical research method with a cross-sectional method. The research was conducted in October-November 2023 with a period starting from October 25, 2023, to November 25, 2023, at Elementary School Muhammadiyah 08, Dau District, Malang Regency, East Java. Based on the research on the strength of students' arm muscles at the age of 10-12 years, it can be concluded that there is a significant increase in the strength of students' arm muscles in the age range of 10-12 years.

Keywords: *Arm muscle strength, Students, Physical Education*

This article is licensed under [CC BY-SA 4.0](https://creativecommons.org/licenses/by-sa/4.0/) 

INTRODUCTION

Every child experiences development; development occurs from an early age to adulthood. Development is progressive, systematic and sustainable. The things that develop in each child are the same; it is just that there are differences, differences in the speed of development, and there are developments that precede previous developments, even though the development between one aspect and another occurs in tandem (Khaironi, 2018). Developmental aspects in children are physical-motor, cognitive, language, and social-emotional aspects. These aspects of child development will only develop if stimulation and encouragement are given. One of the developmental aspects that needs to be developed is motor (Mu'mala & Nadlifah, 2019)

Motor development is the process of growth and skill development in children. Gross motor skills are skills that involve large muscles in any activity. Hand, shoulder, and wrist muscle handling improve rapidly during childhood (Yulianti et al., 2023). By age 12, muscle control reaches the same level as an adult's. This development develops along with the maturity of the child's nerves, muscles or cognitive abilities (Arifiyanti et al., 2019).

Muscle strength is an integral part of human physical development. Muscle strength increases with frequent and physical exercise, leading to changes in muscle fibers and the neurological system. Muscle strength is the capacity of a muscle or muscle group to complete a job while lifting a specific weight. Strong muscles will improve the efficiency of normal muscle activities such as lifting, carrying, jumping, and jumping, as well as body shape (Muhammad, 2018).

Muscle development is a complex and vital process that involves the growth and maturation of muscle fibers and the nervous system that controls them. This process allows children to develop muscle strength and coordination for daily physical activities (Sabani, 2019). Physical activity is essential for overall growth and development in children. Optimizing the mastery of skills and attitudes that can lead to healthier behaviors in life. Physical activity

Comparative Analysis Of Arm Muscle Strength Based On Gender In Students Aged 10-12 Years At Elementary School Muhammadiyah 08, Dau District, Malang Regency

among children shows that children create their movements. Likewise, parents assume that physical activity is provided through play activities in various places, as gross and fine motor development, and that such activities provide a stimulus for the growth of children's muscle mass as adolescent readiness. The following developmental progress is fundamental to physical development. The child's physical development is the most critical factor in supporting overall growth and development, especially in muscle strength. When the child's physique usually develops, he can improve his physical skills without help from others. Physical development is generally characterized by refined and gross motor development. Muscle strength, especially in the arms, allows for gross motor activity in children. Gross motor activities involve generally movements that involve large muscles, such as the arms, which is the ability of gross motor skills (Burhaein, 2017). The physical education curriculum is an essential component of the education system that seeks to improve students' physical, health, and motor skills. The physical education curriculum covers many topics, including muscle strength, health, and motor development. The student's gender must be considered when developing a physical education program (Sari, 2020).

Children aged 6 to 12 years experience a significant increase in muscle strength, which allows them to perform different types of physical activity more effectively. Muscle strength is necessary not only for performing physical activities but also for daily activities such as writing, throwing, lifting weights, and hanging; arm muscle strength is also necessary for the development of social skills and participating in sports and games (Pratiwi & Nugraha, 2023). Gross motor development is an ability that requires coordination of most of the child's body (Djuanda & Agustiani, 2022). Therefore, it usually involves energy because larger muscles perform it. Gross motor development also requires coordination of children's muscle groups, enabling them to lift, push, hit, curve, swing and pull. In its development, gross motor skills in children will first hold large objects rather than small ones. When holding large objects, the child uses the strength of his arm muscles (Farida, 2016).

The strength of the arm muscles is a factor in children's motor development. Children's gross and fine motor skills are significantly improved between the ages of 10-12. (Prasetya, 2022). Arm muscle strength is essential for daily tasks and success in various physical activities and sports. Here are some reasons why arm muscle strength is measured at that age: to measure physical development in children, to see the readiness of students for physical activity, to identify health problems in students, to monitor growth in students of Elementary School 08 Muhammadiyah Dau Malang. The study was inspired by a lack of data on arm muscle strength in children aged 10-12, which is crucial for evaluating and comparing physical development to established standards.

In this study, muscle strength is essential for gross motor growth, which uses large muscles and relies on the strength of the arm muscles. Physical activity that develops muscle strength can strengthen bones and help children avoid health problems such as obesity and diabetes. In addition, the development of motor skills is closely related to brain growth. Based on the description, the author is interested in conducting a study entitled "Comparative Analysis of Arm Muscle Strength Based on Gender in 10-12 Years Old Students at Elementary School Muhammadiyah 08 Dau Malang.". In this study, two research variables were determined, namely the strength of students' arm muscles and the strength of students' arm muscles and the age of 10-12 years, which could be used as a source of information for the Elementary School Muhammadiyah 08 Kec students.

The formulation of the problem in this study is how the strength of the arm muscles develops in students aged 10-12 years. This study aims to analyze the factors that affect the strength of arm muscles in students aged 10-12 years. To provide new insights into the effects of physical activity and nutrition on arm muscle strength and recommend interventions that can improve muscle strength at 10-12 years of age. The results of this study are expected to provide

Comparative Analysis Of Arm Muscle Strength Based On Gender In Students Aged 10-12 Years At Elementary School Muhammadiyah 08, Dau District, Malang Regency

benefits for sports teachers, coaches, and parents in developing effective programs to increase arm muscle strength in children, as well as contributing to the scientific literature.

The differences in research conducted by (Widhiyanti et al., 2018) This study focuses on the difference in arm muscle strength with partial masase administration and arm muscle strength without partial masase administration. The sample in this study is students of the Faculty of Sports and Health Education, IKIP PGRI Bali, while the sample used by the researcher is elementary school students. The difference in research conducted by (Saparuddin, 2019) is that this study focuses on the effect of giving push-up and pull-up exercises on arm muscle strength in archery athletes in Banjar Regency.

METHOD

This quantitative study uses an observational analytical research method with a cross-sectional method. This study analyzes arm muscle strength based on age in 10-12-year-old students. The chart of the research design to be carried out can be described as follows:

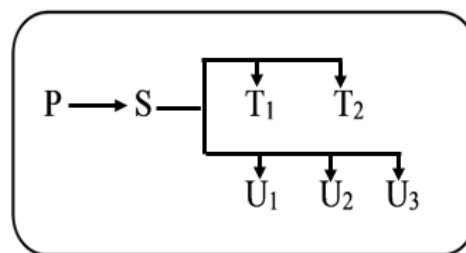


Figure 1. Research Design

Information:

P: Population

S: Sample

T1: Measurement of muscle strength in male students

T2: Measurement of muscle strength in female students

U1: Measurement of arm muscle strength of 10-year-old students

U2: measurement of arm muscle strength of 11-year-old students

U3: Measurement of arm muscle strength of 12-year-old students

The population of this study is students in grades 4, 5, and 6 of Elementary School Muhammadiyah 08, Dau District, Malang Regency. The sample in this study is students and students aged 10-12 years by the inclusion and exclusion criteria set in this study. This research was conducted at Elementary School Muhammadiyah 08 Dau District, Malang Regency. This research will be carried out at Elementary School 08, Dau District, Malang Regency, East Java, Indonesia, and this research will be carried out from October 2023 to December 2023.

RESULTS AND DISCUSSION

The research was conducted in October-November 2023 with a period starting from October 25, 2023, to November 25, 2023, at Elementary School Muhammadiyah 08, Dau District, Malang Regency, East Java. Data was collected for four weeks with a sample of 116 people. The age group is divided into three groups: the 10-year-old age group, the 11-year-old age group and the 12-year-old age group.

A. Data Analysis Results

1. Normality Test

a. Age Normality Test With Arm Muscle Strength

Table 1. Age Normality Test With Arm Muscle Strength (Personal Data, 2023)

Age Level	n	Sig.
10 years	37	0,9
11 years	43	0,0
12 years	36	0,7

Based on the results from the table, the results of the Kolmogorov-Smirnov normality test in students aged 10-12 years using a handgrip dynamometer are <0.05 , so it can be concluded that the data is abnormally distributed.

b. Sex Normality Test With Arm Muscle Strength

Table 2. Respondent Characteristics Based on Arm Muscle Strength (Personal data, 2023)

Gender	n	Sig.
man	61	0,00
woman	55	0,21

Based on the results from the table above, the results were obtained in children by gender. From these results, it can be concluded that the normality test using Kolmogorof-Smirnov using the Hangripdynamometer is $\text{sig} < 0.05$ eat, the data can be categorized as not normally distributed.

c. Homogeneity Test

Table 3. Homogeneity Normality Test (Personal Data, 2023)

Arm Muscle Strength Values	Sig.
	0,11

A homogeneity test is a statistical test procedure that aims to show that two or more data were taken from the same population. Based on the table above, the test value results were obtained at 0.11, so from the results obtained, it can be concluded that the data is homogeneous because of the value of $\text{sig} > 0.05$.

2. Comparison Test

a. In this study, an analysis was carried out using the Kruskal-Walis test to evaluate the difference in the average level of

Table 4. Kruskal-Wallis Test Results (Personal Data, 2023)

Variable	Sig.
Arm Muscle Strength	0.6

The results of the comparative test based on the table above obtained a significant value of 0.6, where the result was more than 0.05, indicating that H2 was accepted and H3 was rejected so that it can be stated that there is no difference in arm muscle

strength between the age range of 10, 11 and 12 years in the students of Elementary School Muhammadiyah 08 in Dau District, Malang Regency.

b. The Mann-Whitney test was used to analyze the comparison between sex and the strength of students' arm muscles

Table 5. Mann Whitney Test (Personal Data, 2023)

Variable	Sig.
Arm Muscle Strength	0.00

In the data of the table above of the Man Whitney Test, it can be concluded that there is a significant difference in the strength of the arm muscles of students and students; this can be known through sig. > 0.05 is nlai p-value 0.00. The results of the comparative test based on the table above obtained a significance value of 0.00, where the result was less than 0.05, indicating that H1 was rejected and H0 was accepted so that it can be stated that there is a difference in arm muscle strength in students of Elementary School Muhammadiyah 08 dau district, Malang Regency.

B. Comparison of Students' Arm Muscle Strength Levels Based on Age 10-12 Years

Based on the study's results, an analysis of the Kruskal-Wallis test that was carried out stated that there is no difference in arm muscle strength among students based on age. Proven by the results of sig. P-value sig. 0.6, which means the value of sig. P-value > 0.05 . In elementary school, physical development is characterized by height growth, strengthening of bones and muscles, fine motor development, agility, and flexibility. Physical development will run more smoothly if the child is actively moving. These movements can be done through sports or recreational activities. One approach to measuring child growth is to use a child growth assessment that considers height, weight, body mass index (BMI), arm circumference, head circumference, and other factors (WHO, 2008). Exercises that can help physical growth between the ages of 6 and 8 include posture improvement, jumping, agility, balance and strength training, rhythmic activities with music, etc.

By the age of 9, body movements are directed to grow muscle strength through heavier sports training and the practice of various game skills (soccer, basketball), swimming, athletics, and so on. At the age of 10 to 11, body growth is focused on the main muscles, strength coordination, direction of movement, and body flexibility. Children at this age will benefit from practicing floor exercises. By the age of 12-13, the growth of the body, bones, and muscles matures through strength-based exercises. At the age of 12-13, the body, bones, and muscles mature through exercises emphasizing strength, precision, and direction of movement, such as team sports games/activities (Burhaein, 2017). At ten or in grade IV of elementary school, students take Kali lessons, which are meant to increase arm muscle strength. Research conducted by (Komari, 2019) which in his study obtained the results that in grade VI, there were still many students whose arm muscle strength was below average.

At 11 years or grade V of elementary school, students must also take physical education and sports subjects. The material in class V is used to measure arm strength by asking students to swing and slightly bend elbows, and from these movements, can take a score on arm muscle strength in students, such as research conducted by (Nonce, 2014) with

the title of a survey of the level of physical freshness of grade V students of Negri 25 East Palu Elementary School and the results were obtained that Public Elementary School 25 Palu students have elbow hangings with a medium category, The strength and endurance of the arm muscles possessed by students are very helpful in the process of physical activities at school and home. 12 or grade VI students must also take physical and sports education subjects. In this class VI physical education material, the students are also asked to do the movement of throwing the cast ball hull. The students were asked to perform the movement to monitor whether they could do it well. Moreover, it could be used as a reference for evaluation material for the curriculum, especially in physical education and sports subjects such as research conducted by (Bulan, 2023) with the research title Contribution of Arm Muscle Strength with the Ability to Throw Gastric Balls. The results were obtained that students at Elementary School Negri 96 Kendari could carry out the movement well.

(Nasrulloh & Wicaksono, 2020a) The data collection instrument used is a handgrip dynamometer. During the examination with this instrument, the respondent's hand grip strength was measured in a conventional setting, with the respondent seated, elbows at a 90-degree angle, forearms and wrists in a neutral position, and the dynamometer grip adjusted to the respondent's comfort. After explaining the examination technique and getting familiar with the measuring device, the respondent was instructed to use the maximum grip strength for 3 to 5 seconds. This technique is repeated thrice, alternating each hand with a one-minute time gap between measurements (Darwis et al., 2022). This tool has been used in a study conducted by (Nasrulloh Wicaksono, 2020) with the title Bodyweight exercise with Total Body Resistance Exercise (TRX) can increase muscle strength.

Muscle strength is creating tension and overcoming resistance while performing an activity. Muscle strength is measured by how much resistance or load a muscle can withstand. Lifting larger weights will increase muscle strength (Jahrir, 2019). The relationship and participation of motor skills in muscular endurance is an area that needs improvement. The physical characteristics of students aged 10-12 years include the growth of arm and leg muscles and awareness about their body; in male students who master rough games, the growth of height and weight is not much different. Muscle strength does not support its development; the reaction time is improving. The difference due to gender is more pronounced; coordination is improving, and the body is getting healthier and more robust. At the age of 11 to 12 years, the phases of motor skills in students include developing basic skills of play and movement; students can build endurance such as muscle development and coordination; students can improve speed and precision and resistance to fatigue by increasing intensive activities, students can know how to relax and use rest time, students can develop fatigue resistance (Arifin, 2013).

Muscle endurance is something that should be improved. Children aged 10-11 can develop motor skills, but a lack of experience and understanding of movement can hinder progress. The importance of motor skill involvement. A beneficial relationship for physical endurance while improving health later in life. Physical education is essential in improving and maintaining motor skills and fitness among primary school children (Vedul-Kjelsås et al., 2012). This is because, at that age, students are still in a similar stage of growth and development. In addition, at the age of 10-12 years, students usually have relatively similar

fitness levels because they experience the same growth period, which includes a natural increase in muscle strength with their growth (Pratamalloh et al., 2023).

According to Marwan et al., 2015 students' daily activities revolve around studying in school, where they hone their intelligence and prepare themselves for the future. At school, the students participate in various topics, from exact sciences to art, all of which contribute to developing their character and knowledge. However, students' lives are also enriched with other equally important activities. Working to help parents, for example, allows children to apply principles such as responsibility and hard work.

This can be doing simple chores at home or helping out at the family business, which teaches essential life skills. Playing sports in clubs has both physical and mental advantages. Students who participate in sports learn about the value of staying healthy, collaboration, and healthy competition. Sports groups are often locations where people can achieve physical excellence while making friends. Extracurricular activities such as debates, music, and art groups allow students to develop their interests and abilities outside the academic curriculum. These activities enhance the student learning experience while promoting the development of interpersonal and leadership skills. Physically fit students will have an easier time participating in these activities. Physical fitness improves physical abilities and helps with focus and emotional well-being, which are necessary for success in all aspects of life.

The physical ability demands in grades IV, V, and VI differ in curriculum. These abilities require little increased muscle strength. Although there was no significant difference between the ages of 10-12, there was a difference in the increase in the average value of upper arm muscle strength where the age of 10 years (55.92), 11 years (57.47), and 12 years (62.39) was seen.

C. Comparison of students' arm muscle strength levels by gender

Based on the results of the comparative test using the Mann-Whitney test based on table 5.7, the results of the comparative test based on the table above obtained a significance value of 0.00 where the result is less than 0.05, indicating that H1 is accepted and H0 is rejected so that it can be stated that there is a difference in arm muscle strength in students of Elementary School Muhammadiyah 08, Dau District, Malang Regency. Arm muscle strength is a person's ability to use the entire strength of the arm muscles that are mobilized in the shortest possible time while performing a squeezing motion. The strength of the arm muscles can be affected by a person's nutritional status; A person with poor or excessive nutritional status will have lower strength than someone with adequate nutritional status.

The strength of the arm muscles can be assessed with a dynamometer, which measures the strength of the hand's grip. Hand grip strength is also used in clinical settings to check nutritional health and physical fitness and to anticipate various diseases. In addition, hand grip strength is used as a therapeutic approach and impacts the efficacy of several hand care procedures, including hand rehabilitation. Women and men have similar muscle strength, but after adolescence (age 10-12), the dominant male arm muscle strength is stronger than the female arm muscle strength. This is due to increased concentrations of testosterone, IGF-1 (Insulin-like Growth Factors), and growth hormone in men during puberty, resulting in a significant increase in muscle mass and forming a broader shoulder posture. The difference

Comparative Analysis Of Arm Muscle Strength Based On Gender In Students Aged 10-12 Years At Elementary School Muhammadiyah 08, Dau District, Malang Regency

in muscle strength between boys and girls is also related to differences in size, the amount of muscle fibers and their distribution throughout the body (K. Intan et al., 2021).

Men usually have more muscle tissue than women. In addition, men have a higher amount of androgen hormones than women. This hormone is one of the causes of muscle hypertrophy, which increases muscle strength. According to Al-Asadi (2018), men have a higher average grip strength than women, which indicates that differences in the type of activity performed by both sexes can change muscle strength. Women's muscle strength decreases as they enter adulthood, while men's strength increases. This is due to the larger muscle fibers in men than in women. In addition, the hormone testosterone in men also contributes to this disease. Men are more potent than women because testosterone promotes muscle growth (Jaya Wikrama et al., 2023).

CONCLUSION

Based on the research on the strength of students' arm muscles at the age of 10-12 years, it can be concluded that there is a significant increase in the strength of students' arm muscles in the age range of 10-12 years. This shows that the growth period is crucial to developing muscle strength. Variations Exercise also involves the arm muscles, which, when performed regularly, contributes to a significant increase in muscle strength. Students who engage in higher physical activity tend to have better arm muscle strength compared to students who are less active in physical activity. To increase the strength of students' arm muscles based on the age of 10-12, it is recommended that schools and parents encourage students to participate in physical activities and physical activities regularly. Holding a unique training program for arm muscles can be integrated into the physical education curriculum in schools. The examination and evaluation of arm muscle strength can be carried out periodically to monitor the development of students and adjust the exercise program as needed to develop muscle strength.

REFERENCES

- Arifiyanti, N., Fitriana, R., Kusmiyati, R., Sari, N. K., & Usriyah, S. (2019). Motorik Kasar Anak Usia Dini. *Al Athfal: Jurnal Kajian Perkembangan Anak Dan Manajemen Pendidikan Usia Dini*, 2(1), 36–44.
- Burhaein, E. (2017). Aktivitas fisik olahraga untuk pertumbuhan dan perkembangan siswa SD. *Indonesian Journal of Primary Education*, 1(1), 51–58.
- Djuanda, I., & Agustiani, N. D. (2022). Perkembangan Kemampuan Motorik Kasar Melalui Kegiatan Tari Kreasi Pada Anak Usia 5-6 Tahun. *Almarhalah*, 6(1), 33–45.
- Farida, A. (2016). Urgensi perkembangan motorik kasar pada perkembangan anak usia dini. *Jurnal Raudhah*, 4(2).
- Khaironi, M. (2018). Perkembangan anak usia dini. *Jurnal Golden Age*, 2(01), 1–12.
- Mu'mala, K. A., & Nadlifah, N. (2019). Optimalisasi permainan lompat tali dalam mengembangkan motorik kasar anak. *Golden Age: Jurnal Ilmiah Tumbuh Kembang Anak Usia Dini*, 4(1), 57–68.
- Muhammad, J. (2018). Perkembangan kemampuan fisik (kelentukan, kekuatan otot ekstensor, dan kelincahan) orang dewasa muda ditinjau dari usia dan etnik. *Journal Power of Sports*, 1(2), 1.
- Prasetya, Y. E. (2022). Analisis Kemampuan Kecepatan Dan Kekuatan Perut Anak Usia Dini 9-10 Tahun Sdn 188 Gresik Setelah Era Pandemi. *Jurnal Kesehatan Olahraga*, 10(03), 97–102.
- Pratiwi, A. D., & Nugraha, H. (2023). Model permainan akurasi lempar pisau pada anak usia 10-12 tahun. *Journal Olahraga Rekat (Rekreasi Masyarakat)*, 2(1), 38–49.

- Sabani, F. (2019). Perkembangan anak-anak selama masa sekolah dasar (6–7 tahun). *Didaktika: Jurnal Kependidikan*, 8(2), 89–100.
- Saparuddin, S. (2019). Pengaruh latihan push-up dan pull-up terhadap kekuatan otot lengan pada atlet panahan perpani kabupaten banjar. *Riyadhoh: Jurnal Pendidikan Olahraga*, 2(2), 36–43.
- Sari, D. N. (2020). Tinjauan kebugaran jasmani siswa sekolah dasar. *Jurnal Sporta Sainatika*, 5(2), 133–138.
- Sobirisani, I., & Komari, A. (2019). Hubungan Kekuatan Otot Lengan Dan Kemampuan Memukul Bola Kasti Siswa Kelas Ivb Sdn Tegalpanggung. *Pgsd Penjaskes*, 8(4).
- Widhiyanti, K. A. T., Ariawati, N. W., & Rusitayanti, N. W. A. (2018). Pengaruh Pemberian Masase Partial Sebagai Tambahan Pemanasan Terhadap Kekuatan Otot Lengan. *Jurnal Pendidikan Kesehatan Rekreasi*, 4(2), 82–87.
- Yulianti, A., Dhiyah, E. H., Peluw, K. I. H., & YA, N. U. R. A. F. B. (2023). Analisa komponen fisik pada anak dengan cerebral palsy spastik. *Physiotherapy Health Science (PhysioHS)*, 6(2).