

## Original Research

### Normal Walking Speed According to Age and Gender in Preliminary Students in Surabaya

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#### ABSTRACT

**Background:** Studies on walking have been developed recently because the speed of walking plays an important role in making predictions related to physical health. However, studies of walking speed in children are still relatively few even though the need for such data is quite high considering that walking speed can be used as a parameter to measure physical health.

**Aim:** The purpose of this study is to know the difference in walking speed based on age and gender in elementary school students.

**Material and Methods:** This study used an analytic observational study with a cross-sectional approach. All samples are students from Mojo VI State Elementary School Surabaya aged 7 to 12 years who meet the inclusion criteria using 10-meter walk test. The variable studied was walking speed. Method of sampling was conducted at Mojo VI State Elementary School Surabaya. Walking speed analysis was carried out by using the Kruskal-Wallis test for walking speed based on age and an unpaired T test for walking speed based on gender.

**Results:** This research included 170 subjects that are 90 males and 80 females. Based on age, seven years old students have an average walking speed of  $(1.30 \pm 0.21)$  m/s, eight years old students with  $(1.23 \pm 0.18)$  m/s, nine years old students with  $(1.24 \pm 0.17)$  m/s, ten years old students with  $(1.24 \pm 0.19)$  m/s, eleven years old students with  $(1.31 \pm 0.22)$  m/s, and twelve years old students with  $(1.27 \pm 0.20)$  m/s. Based on gender, the average walking speed obtained in male was  $(1.26 \pm 0.19)$  m/s, while the average walking speed obtained in female was  $(1.26 \pm 0.20)$  m/s.

**Conclusion:** There is no difference in the speed of walking based on age ( $p=0.440$ ) at the age of 7 to 12 years and in both genders ( $p=0.910$ ).

**Keywords:** Age, Elementary School Student, Gender, Walking Speed

## **Introduction**

Walking is a basic activity that normal humans can do in general. Many studies on walking have been developed recently. This is because walking speed affects the basic elements of gait, such as joint rotation, soil reaction force, internal joint momentum and joint strength, muscle activity, and spatio-temporal gait parameters.<sup>1</sup> However, studies on walking speed in children are still relatively limited even though the need for such data is quite high as it is considered as a reliable, valid, sensitive, and specific measure that is also chosen by some experts as the standardized assessment to measure locomotion for the Motor Function Domain in NIH Toolbox.<sup>2</sup>

Children have a fairly high ratio in the demographics of the Indonesian population. According to the Central Statistics Agency,<sup>3</sup> projections for the total population of Indonesia show that children aged 5-9 years and 9-14 years from 2010 to 2035 are always above 10 million population for both male and female. This shows the importance of maintaining the mobility of young children in order to maintain their productivity later in adulthood. The importance of this is also shown in Indonesian Basic Health Research data<sup>4</sup> regarding the proportion of injuries that resulted in disruption of daily activities in the past year for all age groups. This proportion increased from 7.5% in 2007 to 9.2% in 2018. Thus, it is hoped that this study of walking speed can be useful in reducing this figure by presenting normal data for better rehabilitation.

Another importance of research about walking speed in children is because childhood is the phase that a person experiences the fastest physical growth in his lifetime in terms of height. According to the WHO chart<sup>5,6</sup> which shows the height growth of children from 5-19 years of age, the height of female in general experiences a drastic growth at the age of 5-15 years, and there is a significant slowdown at the age of 15-19 years. On the contrary, the height growth in male was not as drastic as in female. However, with

a longer duration at the age of 5-17 years and with a significant slowdown at the age of 17-19 years, this certainly opens the possibility that there is a difference in walking speed in each age group during growth and in each gender due to different growth rates. This possibility needs to be investigated further because by doing so, future research on walking speed, especially in children can be done in more detail. Therefore, a decision was made to examine the walking speed of children in elementary school students. This decision was made because elementary school students have a wider variety of age groups than junior and senior high schools.

The expected benefits of this study include obtaining more up-to-date data on children's normal walking speed according to age and gender, opening up new opportunities for conducting research on walking speed, especially in children, and becoming a source of the latest data on normal walking speed in children. This study aims to analyze differences in walking speed based on age and gender in elementary school students.

## **Material and Methods**

This research is an analytic observational study with cross-sectional method, by collecting patient data through a 10-meter walking test. The 10-meter walking test is commonly used to measure walking speed in meters per second over a short distance with a fairly short time.<sup>7</sup> This method was chosen because it is known to have a sufficient reliability in typical children especially when it comes to test-retest reliability.<sup>8</sup> This research was conducted at Mojo VI State Elementary School Surabaya. Samples were taken according to the inclusion and exclusion criteria with a total sample size of 170 people. The sample size of this study used total sampling.

Students who were not willing to take part in the study and students who had walking disorders were the exclusion criteria in this study. Walking disorders were described as students with musculoskeletal to a neurological disturbance. Students were interviewed first to ensure that there is no history of gait disturbance. Meanwhile, the inclusion criteria were male and female students of Mojo VI State Elementary School Surabaya, aged 7 to 12 years, physically and mentally healthy, and were able to cooperatively participate in the research. The variables studied were age,

gender, and walking speed which were measured by using the 10-meter walking test. This research has obtained a certificate of ethical clearance issued by Research Ethics Committee of Faculty of Medicine, Universitas Airlangga (No. 142/EC/KEPK/FKUA/2020).

### Results

After taking a total sample of 170 people, the results were obtained in Table 1, Table 2 Table 3, and Table 4.

**Table 1. General Characteristics of Research Subject**

Variable	Number (n)	Percentage (%)
<b>Gender</b>		
male	90	52.9%
Female	80	47.1%
<b>Age (years)</b>		
7	24	14.12%
8	32	18.82%
9	29	17.06%
10	33	19.41%
11	25	14.71%
12	27	15.88%

**Table 2. Distribution of weight, height, and BMI based on age**

Age (years)	Weight (kg)	Height (cm)	Body Mass Index (BMI)
7	21 (18.5-25.75)	119.5 (117-126)	14.72 (13.54-17.15)
8	21 (19.25-26)	124.5 (121-126.75)	14.62 (13.20-16.76)
9	26 (22.5-32.5)	130 (127-136.5)	15.59 (13.48-18.09)
10	30 (23.5-35)	135 (130-138)	15.77 (13.63-18.75)
11	38 (29-40.5)	145 (139-149)	17.35 (15.11-18.67)
12	41 (35-50)	150 (145-154)	17.94 (16.20-23.47)

**Table 3. Distribution of weight, height, and BMI based on gender**

Gender	Weight (kg)	Height (cm)	Body Mass Index (BMI)
Male	28 (22-39)	129 (125-143.25)	16.06 (14.36-18.53)
Female	29 (22-37.75)	132.5 (126.25-143.75)	16.03 (13.62-18.35)

**Table 4. Walking speed based on age**

Age (years)	Walking speed (m/s)	Kruskal-Wallis test
7	1.30 ± 0.21	$p = 0.440$
8	1.23 ± 0.18	
9	1.24 ± 0.17	
10	1.24 ± 0.19	
11	1.31 ± 0.22	
12	1.27 ± 0.20	

After taking the walking speed data based on the age of 7 to 12 years, it was found that the highest average walking speed was at the age of 11 years and the lowest average walking speed was at the age of 8 years. After performing the Kolmogorof-Smirnov normality test, the values were not normally distributed (age 7 years  $p = 0.014$ , age 8 years  $p = 0.2$ , age 9 years  $p = 0.2$ , age 10 years  $p = 0.082$ , age 11 years  $p = 0.2$ , age 12 years  $p = 0.019$ ). Therefore, the Kruskal-Wallis test was performed and the  $p$  value was obtained ( $p = 0.440$ ). Because  $p > 0.05$ , it can be concluded that there is no difference in walking speed at the age of 7 to 12 years.

**Table 5. Walking speed based on gender**

Gender	Walking speed (m/s)	Unpaired T test
Male	1.26 ± 0.19	$p = 0.910$
Female	1.26 ± 0.20	

After taking the walking speed data for male and female, it was found that the

walking speed was almost the same where the difference was in the standard deviation. Furthermore, the normality test was carried out and the results of the data were normally distributed (male  $p = 0.157$ , female  $p = 0.200$ ). Then the homogeneity test was carried out and the results of the data were homogeneous ( $p = 0.937$ ). Finally, an unpaired T test was performed with the result of  $p = 0.910$ . From the results obtained, because  $p > 0.05$ , it can be concluded that there is no difference in walking speed between the gender of male and female.

**Discussion**

In this study, there were 170 research subjects who had been selected by taking into account the inclusion and exclusion factors with a composition of 90 male and 80 female. In each gender, the research subjects were grouped by age into 7, 8, 9, 10, 11, and 12 years of age. This grouping is carried out based on the age of the child in the elementary school.

This distribution is in accordance with an article written by Itzkowitz *et al*<sup>9</sup> which uses the distribution according to age without grouping several age levels into one group. The age distribution is limited

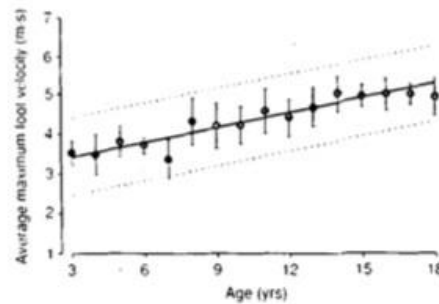
to 7 to 12 years because ages above or below this limit are only slightly found at the research location concerned. This is different from the research of David and Sullivan<sup>10</sup> which has an age limit of 6 to 11 years. This difference may be due to differences in school age since the study was conducted in Iowa, USA.

Based on the walking distance data for children aged 6 to 13 years in 30 seconds in this study, data on the average height of male and female research subjects were obtained. When compared with research subjects by Knutson *et al.*,<sup>11</sup> it was found that a significant difference in height. It was likely due to racial differences because the study was conducted in Iowa, USA. This needs to be highlighted as height plays an important role in walking speed.<sup>12</sup>

Based on the data that has been obtained and analyzed, the results show that there is no difference in walking speed at the age of 7 to 12 years. The closest research to this is David and Sullivan's study entitled Expectations for Walking Speeds: Standards for Students in Elementary Schools.<sup>10</sup> It was found that there was no significant difference in walking speed at different age levels in the present study, in contrast to David and Sullivan's study which found that there was an increase in walking speed at higher grade levels. There are several points that can underlie this difference in results. The age studied in the present study was not as wide as David and Sullivan's study, which is only from the age of 7 to 12 years, in contrast to their study which used research subjects aged 3 to 11 years. This is because this study only uses elementary school students as the research subjects, while David and Sullivan include kindergarten students in their research subjects.

There is also another similar study from Wheelwright *et al* in 1993 entitled Temporal and Spatial Parameters of Gait in Children. I: Normal Control Data.<sup>13</sup> In this study, the results of walking speed that did not have a significant pattern and tended to be similar were obtained, whereas in Wheelwright *et al*'s study, the results of walking speed were linear with increasing age. The results in this study were quite different from the findings in their study.

What might cause this difference is the age range studied.



**Image 1. Graph of the relationship between walking speed according to age in male and female aged 3 to 18 years taken from Wheelwright *et al*<sup>13</sup>**

From comparisons with other studies with similar topics, it can be concluded that the reason for not finding a difference in walking speed based on age that can be considered is that the age range in this study was not wide enough to obtain a significant result. With a wider range, some differences in walking patterns that is developing as children grow can be seen more dramatically such as how younger children have a lower average walking speed, shorter step length, higher cadence, wider support base and a more prolonged double support phase.<sup>14</sup>

Based on the data that has been taken and analyzed, it can be concluded that there is no difference in walking speed between the gender of men and female. This is similar to the research of Wheelwright *et al*<sup>13</sup> in 1993. In this study, observations of gait parameters in children aged 3 to 18 years were observed by attaching punch tape to the legs of the research subjects and asking the research subjects to walk. In the research results, it is concluded that there is no significant relationship between normal walking speed and gender. This happens because although there are differences in height, female tend to walk with a shorter swing phase than men.

This study also obtained results that were similar to that of Knutson *et al*<sup>11</sup> in 1999 regarding a thirty-second walk test conducted on children aged 6 to 13 years. In this study, subjects were asked to walk for 30 seconds and then measured the distance covered in the given time.

Although it has different forms, conceptually this study has the same goal, namely knowing the walking speed by calculating the distance traveled and time. From the results of Knutson *et al*'s study, it was concluded that there was no relationship between age and gender and the distance traveled.

## Conclusion

From the results of the Kruskal-Wallis test and unpaired T test, it can be concluded that there was no difference in walking speed at the age of 7 to 12 years and there was no difference in walking speed for the gender of male and female. Therefore, it can be said that these variables within this range have little to none considerable variation when it comes to walking speed as a measure.

Factors that can be improved are such as it is necessary to do research with a wider age range to get more concrete results and it is necessary to add other variables such as leg length or BMI to determine the factors that affect the normal walking speed of children.

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