

# A Study on the Standardization of the 6-Minute Walking Test for Elderly Koreans

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## Abstract

**Background/Objectives:** 6-minute walking distance is a method for evaluating cardiopulmonary function and assessing physical performance. However, the data used in clinics are calculated from Americans. So we measure distance for Asians.

**Method/Statistical Analysis:** In this study, measurement of 6-minute walking distance was performed according to the 2003 American Thoracic Society guidelines. We measured the 6-minute walking distance, body mass index, oxygen saturation, heart rate, and blood pressure.

**Findings:** The mean 6-minute walking distance of elderly Koreans was found to be 458.5 m. The mean 6-minute walking distances for elderly Korean men and women were determined to be 470.01 m and 452.18 m, respectively, with a statistically significant difference ( $p < 0.05$ ).

**Improvements/Applications:** Although Koreans do not represent all Asians, it is necessary that calculations of the 6-minute walking distance are tailored for the Asian population or using the body muscle mass weight.

**Keywords:** 6-minute walking test, aerobic exercise, cardiopulmonary capacity, Asian, elderly population.

## Introduction

In many countries, the rapid increase of the elderly population has led to an increase in the number of patients with cardiovascular diseases such as heart failure and coronary heart disease. Excessive exercise can adversely affect the health of the elderly. Therefore, a test is needed to evaluate the function of the cardiovascular system and prescribe individualized aerobic exercise levels. The 6-minute walk test (6MWT) is a field walk test developed to evaluate the condition, prognosis,

and appropriateness of treatment for cardiopulmonary diseases based on the 12-minute run test developed in 1978 [1]. The measurement method is simple and inexpensive as the walking distance is calculated by measuring the speed of an individual walking as fast as possible for 6 minutes, and it is widely used in clinical settings to estimate the maximum oxygen consumption using an equation [2]. Therefore, the 6MWT, which is continuously used all over the world [3], is considered a useful test for patients with chronic cardiopulmonary disease [4].

In addition, the 6MWT is a useful tool for evaluating pedestrian endurance in terms of function, and it is a criterion for determining the degree of mobility in individuals [5-7]. As such, the 6MWT is a commonly used walking test because of its ease and simplicity, and it is effectively used for predicting maximum athletic performance in many population groups [8].

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Since the 6MWT is widely used, various researchers have developed several equations to calculate the standard walking distance using physical characteristics such as height, weight, and sex [9].

However, a single formula cannot reflect the differences in demographic, physical, environmental, and physiological characteristics of each region, which lead to discrepancies in values between subjects and countries. Consistent progress has been made on the standardization of the 6-minute walking distance [10,11].

Moreover, the 6MWT currently in use was developed for use 20 years ago, and the average body size of people has increased since then. A 6MWT different from that used for Westerners is needed for Asians as the 6MWT currently in use was developed for Westerners [12].

Many countries are already working on 6MWT standardizations that reflect their demographic, physical, environmental, and physiological characteristics; however, there is a lack of research on this aspect, in Asia. Therefore, this study aimed to standardize the 6MWT tailored for the demographic characteristics of elderly Asians by constructing a database using measurements of the standard 6-minute walking distance of elderly Koreans aged 65 and above.

### Method

This study was reviewed by the Institutional Review Board. From June 1, 2017 to May 31, 2018, a cross-sectional survey was conducted on 300 elderly people over 65 years of age who agreed to participate in the study in S city, Gyeonggi-do. Subjects with a body mass index (BMI) of 35 kg/m<sup>2</sup> or higher and those with cardiopulmonary disease, neurological disorders, orthopedic diseases associated with pain while walking, or other diseases that could affect the test were excluded from the study.

**The 6MWT:** The 6MWT was based on the 2003 American Thoracic Society guidelines [13]. A biosignal meter was used to measure BMI, oxygen saturation (SPO<sub>2</sub>), heart rate (HR), and blood pressure (BP). For safety during the study, leg pain, dyspnea, and chest pain were evaluated using a leg pain scale, a dyspnea scale, and a chest pain scale, respectively.

**Intervention:** Height, weight, and BMI were measured as general subject characteristics. For uniformity, all the measurements were made indoors

and the subjects were provided with shoes. The subjects undertook two 6MWTs and the longer distance covered was recorded. In addition, SPO<sub>2</sub>, HR, and BP were measured before and after the test.

**Data Analysis:** The SPSS 20.0 program was used in this study to calculate the mean 6-minute walking distance according to sex and the 6-minute walking distance for all the subjects. Correlation analysis was conducted to determine the effect of each variable. The significance level ( $\alpha$ ) for verifying statistical significance was 0.05.

### Result and Discussion

**1. General characteristics of subjects and 6MWT results:** The 106 men enrolled in this study had a mean age of 76.66 ± 4.18 years, a mean height of 166 ± 5.27 cm, a mean weight of 65.58 ± 9.45 kg, and a mean BMI of 28.16 ± 3.57 kg/m<sup>2</sup>. The 194 women in this study had a mean age of 74.01 ± 4.75 years, a mean height of 154.3 ± 5.97 cm, a mean weight of 57.9 ± 7.56 kg, and a mean BMI of 29.53 ± 3.6 kg/m<sup>2</sup> (p<0.05) (Table 1).

**Table 1. General characteristics and mean 6-minute walking distance of elderly Koreans**

	Men (n=106)	Women (n=194)	t	p
Age (years)	76.66 ± 4.18	74.01 ± 4.75		non
Height (cm)	166 ± 5.27	154.34 ± 5.97		non
Weight (kg)	65.58 ± 9.45	57.9 ± 7.56		non
BMI (kg/m <sup>2</sup> )	28.16 ± 3.57	29.53 ± 3.6		non
6MWT distance (m)	470.02 ± 77.31	452.18 ± 64.39	2.134	.034

\* mean ± standard deviation BMI: body mass index 6MWT: 6-minute walking

**2. Correlation Analysis:** Correlation analysis revealed a positive correlation between the 6-minute walking distance and the height of subjects. In other words, the taller the subject, the longer the 6-minute walking distance. On the other hand, a negative correlation was found between the BMI and age of the subjects. In other words, the lower the BMI, the younger the age, and the longer the 6-minute walking distance. Of the characteristics considered, age correlated the most with the 6-minute walking distance (r = -.286), followed by height (r = .172), and BMI correlated the least (r = -.080) (Table 2).

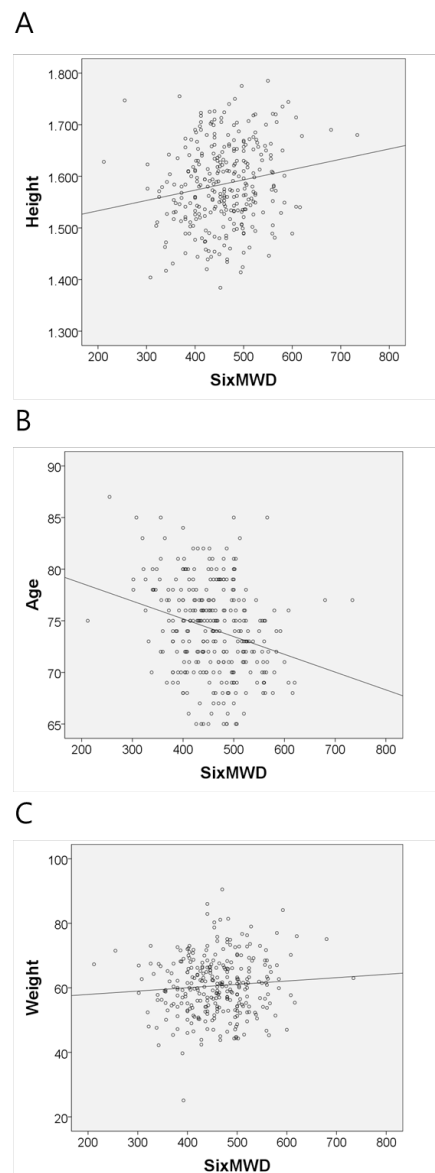
**Table 2. Correlation coefficient**

		<b>6MWT</b>	<b>Height</b>	<b>BMI</b>	<b>Age</b>
6 MW	Pearson	1	.172**	-.080	-.286**
	Significance		.003	.167	.000
Height	Pearson	.172**	1	-.254**	-.064
	Significance	.003		.000	.272
BMI	Pearson	-.080	-.254**	1	.002
	Significance	.167	.000		.972
AGE	Pearson	-.286**	-.064	.002	1
	Significance	.000	.272	.972	

\*\* p< 0.01 level, 6MW: 6-minute walking, 6MWT: 6MW test, BMI: body mass index

We analyzed the factors affecting the 6-minute walking distance, and they included height, weight, and age. The 6-minute walking distance was found to have a positive correlation with height and a negative correlation with age. However, we found that weight had no effect on the walking distance (Figure 1). The aim of this study was to investigate the standardized 6-minute walking distance of elderly Koreans aged 65 years and above and to build a database. Speed and endurance are the main factors that determine mobility during walking [6], and they are frequently used for the prediction and evaluation of community walking ability [5]. For this purpose, 6MWT has been used in many studies [5,6,14].

The mean 6-minute walking distance of men was 470.02 m and that of women was 452.18 m. In an earlier study, mean values were  $598.5 \pm 57.92$  m for men and  $580.9 \pm 47.80$  m for women. The age of the subjects in this earlier study differed from that of the subjects in our study, but the result is consistent with our correlation analysis finding of a negative correlation between the 6-minute walking distance and age. Another previous study reported a mean 6-minute walking distance of 250 m in patients with hemiplegia [6], and yet another study reported a mean 6-minute walking distance of  $516 \pm 195$  m in patients with chronic obstructive pulmonary disease [15]. Although the 6MWT has been performed for healthy adults and for certain disease groups, there has not been sufficient research aimed at determining the 6-minute walking distance of elderly Koreans; therefore, direct comparisons cannot be made. This study makes it possible to assess the current health levels of elderly Koreans.



**Figure 1. Analysis of Factors Affecting 6-Minute Walking distance**

A, Correlation between the walking distance and height. The R value is 0.3. B, Correlation between walking distance and age. The R value is 0.07. C, Correlation between walking distance and weight. The R value is 0.0003.

In a 1998 study by Enright and Sherrill, 2 formulas were put forth to calculate the expected 6-minute walking distance according to sex, and they are as follows: expected 6-minute walking distance for healthy elderly men =  $(7.57 \times \text{height}) - (5.02 \times \text{age}) - (1.76 \times \text{weight}) - 309$  m and expected 6-minute walking distance for healthy elderly women =  $(2.11 \times \text{height}) - (2.29 \times \text{weight}) - (5.78 \times \text{age}) + 667$  m<sup>[16]</sup>. Using the formulas above and the mean values of the general subject characteristics, the expected 6-minute walking distance for men was found to be 447.37 m, which is 22.65 m less than the 470.02 m determined in this study and accounts for a -5.06% difference. Likewise, the expected 6-minute walking distance for women was found to be 432.29 m, which is 19.89 m less than the 452.18 m determined in this study and accounts for a -4.6% difference. In comparison with the above-mentioned previous study, the mean heights of our subjects were 10 cm less in men and 8 cm less in women. From the calculations, it is evident that height, weight, and age are important factors. However, our study showed that weight had no effect on walking distance (Figure 1). It appears that this was because we used only weight. It remains to be analyzed whether the weight was because of excess fat or muscle. The results of this study may necessitate new calculations that take body muscle mass into consideration.

The 6MWT formula is widely used because of its ease of use. However, deviations are considered as resulting from differences in development time, cultural, and environmental characteristics. Therefore, to develop a formula that reflects the environmental and racial characteristics of Asians, studies were conducted on a larger number of elderly people to build a database. Further research is likely to be needed in various countries.

### Conclusion

The aim of this study was to investigate the standard 6-minute walking distance of elderly Koreans. Our results showed a mean 6-minute walking distance of 470.01 m. The difference between the mean walking distances of men and women was 17.8 m; this means that, on average, men cover longer walking distances

than women. Based on the above results, elderly Koreans can measure their own 6-minute walking distance and compare their measurements with the mean value determined in this study. In addition, cardiopulmonary disease may be used as a criterion for the field walking test to measure aerobic capacity and the results can then be compared with those of healthy elderly individuals.

**Ethical Clearance:** Not required

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**Conflict of Interest:** Nil

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