



Six Minute Walking Distance Cut-off Point in Indonesian (Mongoloid) Population

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Abstract

Introduction: Six-minute walk test has been a recommended valid and reliable tool used for functional capacity assessment. American Thoracic Society (ATS) had stated that there are no global standards in interpreting 6-minute walking distance (6MWD) as a one-time measurement of functional assessment, which may be caused by population differences and various 6MWT technique utilized in previous studies. Single time cut off is required to evaluate functional status at the start of a program as a baseline for further follow-up evaluations. It is then a necessity to determine these cut off points in every country/race.

Methods: The study was performed on healthy subjects, sedentary lifestyle, age 18-50, Indonesian ethnicity (Mongoloid race). Recorded data were 6 minute walking distance, also body height and weight. Predicted walking distance based on gender is obtained by calculating walk distance, body weight, body height, gender and subject age in Nury's predicted walk distance formula. Data is analysed with SPSS 20, utilizing independent T-test.

Results: As much as 123 subjects (58 males, 65 females) were included in this study. Mean walking distance for males is 581,98 meters, while females are 516,80 meters, and these differences were statistically significant. Walking distance cut off point between gender were compared. In male subjects, actual walking distance were taken as normal if ≥ 483 meters, poor if 434-483 meters, and very poor < 434 meters. As for female subjects, normal when ≥ 442 meters, poor when 405-442 meters, and very poor in distance < 405 meters. General percentage cut off point in comparison to predicted walking distance was categorized into normal, poor and very poor subgroups. Normal percentage was $\geq 85\%$, poor when distance is 77-85%, and $< 77\%$ categorized as very poor.

Conclusion: There are varying cut off points for walking distance in both males and females. Percentage cut off point as compared to predicted walking distance were not differentiated between genders.

Keywords: cut off point, 6-minute walk test, Indonesian, Mongoloid.

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Nilai Acuan Jarak Tempuh Uji Jalan Menit pada Populasi Indonesia (Mongoloid)

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Abstract

Pendahuluan: Uji jalan 6-menit (**6-Minute Walk test, 6MWT**) merupakan uji yang direkomendasikan sebagai uji yang reliabel dan valid untuk mengukur kapasitas fungsional orang dewasa dengan penyakit paru obstruktif kronis (PPOK). American Thoracic Society (ATS) menyatakan belum ada standar global untuk menginterpretasikan jarak tempuh hasil 6 MWT sebagai status fungsional pada sekali pengukuran, yang kemungkinan disebabkan oleh perbedaan populasi dan metode 6MWT yang digunakan di penelitian-penelitian sebelumnya. **Cut off point** sekali pengukuran diperlukan untuk mengetahui status fungsional pada awal suatu program karena menjadi dasar saat evaluasi berikutnya. Setiap negara/ras dianjurkan membuat nilainya masing-masing.

Metode: Penelitian dilakukan pada subyek sehat (tidak memiliki gangguan kardio respirasi, muskuloskeletal, dan neuromuskular), sedenter, berusia 18-50 tahun, etnis Indonesia (ras Mongoloid). Data yang diambil yaitu tinggi badan, berat badan, dan jarak tempuh yang dihasilkan dari 6MWT. Nilai prediksi jarak tempuh berdasarkan gender diperoleh dengan mengkalkulasikan jarak tempuh, berat badan, tinggi badan, gender, dan usia subyek pada rumus prediksi jarak tempuh Nury. Data dianalisis menggunakan SPSS 20, menggunakan uji T tidak berpasangan.

Hasil: Sebanyak 123 subyek (58 laki-laki, 65 perempuan) disertakan dalam penelitian ini. Rerata prediksi jarak tempuh pada subyek laki-laki yaitu 581,98 meter; sedangkan rerata pada subyek perempuan yaitu 516,80 meter. Tampak perbedaan yang bermakna secara statistik. Hasil persentase pada prediksi jarak tempuh sesuai gender tidak didapatkan perbedaan bermakna pada subyek laki-laki terhadap perempuan, yaitu 99,98%. **Cut off point** jarak tempuh dibedakan berdasarkan gender laki-laki dan perempuan dan dikategorikan menjadi kelompok normal, **poor**, dan **very poor**. Pada subyek laki-laki, jarak tempuh aktual dikategorikan normal bila ≥ 483 meter; **poor** bila 434-483 meter; **very poor** bila < 434 meter. Pada subyek perempuan, jarak tempuh aktual dikategorikan normal bila ≥ 442 meter; **poor** bila 405 meter – 442 meter; **very poor** bila < 405 meter. **Cut off point** persentase terhadap nilai prediksi jarak tempuh, tidak dibedakan pada subyek laki-laki dan perempuan, dan terbagi atas tiga kelompok, yaitu normal, **poor**, dan **very poor**. Persentase normal yaitu $\geq 85\%$, **poor** yaitu 77% - 85%, **very poor** yaitu $< 77\%$.

Kesimpulan: Terdapat **cut off point** yang berbeda untuk jarak tempuh subyek laki-laki dan perempuan. **Cut off point** persentase terhadap nilai prediksi jarak tempuh tidak dibedakan pada subyek laki-laki maupun perempuan.

Keywords: cut off point, 6-minute walk test, Indonesian, Mongoloid.

Introduction

6-Minute Walk Test (6MWT) is a recommended valid and reliable test to measure functional capacity of adults with Chronic Obstructive Pulmonary Disease (COPD).¹⁻³ Morard⁴ had reported that 6 MWT could be utilized in other chronic disabilities due to cardiovascular and respiratory etiologies besides COPD. The utilization of 6MWT to evaluate stroke patients were also common in clinical practice.⁵ Dunn⁵ reviewed 127 articles that reported 6MWT in stroke survivors. 6MWT has become a commonly used functional capacity assessment for various disorders, be it from cardiorespiratory, musculoskeletal or even neuromuscular etiologies.

Walking distance is the main output of 6MWT. There are several instruments which could be used to further analyze the walking distance, which includes percentage prediction of walking distance,⁶ Minimal Clinically Important Difference (MCID),^{1,7,8} and predicted VO_2 max. For both predicted walking distance and VO_2 Max is obtained using a linear regression formula which incorporates walking distance and other variables as predictors.⁸⁻¹¹ MCID then compares actual walking distance before and after intervention.

American Thoracic Society (ATS)¹ had stated that there was no global standard to interpret 6-minute walking distance as an assessment of functional capacity in a single

measurement, which could be affected by population differences and 6MWT methods utilized in previous studies. Therefore, it is then recommended to explore these cut off points in every country/race. This study is aimed to obtain cut off point for walking distance, which includes actual walking distance and comparison of walking distance against the predicted value for Indonesian (Mongoloid race) in 6MWT at a single measurement. It's also known that no previous studies had ever discussed a single measurement walking distance. Besides being the simplest measurement, walking distance cut off point itself could be used even before incorporating it into a formula, making it one choice of variables available for evaluation.

Single measurement cut off point is required to obtain baseline information on functional status in order to show changes during follow-up examination. This study was performed on healthy subjects, aligned with the Guidelines for Cardiac Rehabilitation and Secondary Prevention Programs¹² which recommended healthy subject reference values. This study did not discuss predicted cut off point of VO_2 Max and MCID, as MCID is regarded as an evaluation which compares 6MWT results before and after intervention.

Methods

The study was only performed after obtaining ethical clearance (No. 460/PT02.FK/ETIK/2009) on December 21st, 2009. Data was obtained in 2010, with healthy subjects, adopts sedentary lifestyle, and age ranging from 18 to 50 years old. Subjects were also verified to be of Indonesian ethnicity (Mongoloid race). Other data that were taken includes body height, body weight, and 6 minute walking distance from 6MWT. All subjects had signed the informed consent.

Healthy subjects criteria comprises of subjects without cardiorespiratory, musculoskeletal, and neuromuscular disorders. Screening of cardiorespiratory disorders were carried out with electrocardiography (EKG) and spirometry. On the other hand, musculoskeletal and neuromuscular disorders were screened with anamnesis and physical examination. Body Mass Index (BMI) of subjects were all in normal range according to WHO.¹³

Number of subjects were calculated with three approaches. (1) Using the rule of thumb, 5 to 10 subjects for every independent variables, and thus yields 80 subjects. (2) Utilizing a linear regression formula with independent variables accounted. There were 8 independent variables, with $\hat{a}=5\%$, $\hat{a}=20\%$, and $R^2 25\%$, yielded a total of 54 subjects. (3) Using a one-sample situations for a population proportion (two-sided test), with 95% confidence intervals, 90% power, 65% anticipatory proportion, and initial proportion based on the study as much as 40%. These calculations then gave an estimation of 113 subjects. In this study, the final number of subjects used were 123 subjects.

Data Analysis

Data was analyzed in SPSS 20. Descriptive data was presented along with values from independent T-Test, the same follows for predicted walking distance based on gender, and percentage walking distance against predicted walking distance based on gender. Predicted walking distance based on gender was obtained by calculating walking distance, body weight, body height, gender, and age incorporated to Nury's predicted walking distance¹¹: $586,254 + 0,622 \text{ BW (kg)} - 0,265 \text{ BH (cm)} - 63,343 \text{ gender}^* + 0,117 \text{ age}$.

In order to obtain the percentage values based on gender, actual walking distance is compared with predicted walking distance, and are presented in percentage for each gender.

Results

Study results were presented in five different tables. Subject characteristics used in the study are displayed on table 1. Table 2 shows predicted walking distance based on age, while table 3 shows percentage predicted walking distance based on age. Actual walk distance in 6MWT for both genders were shown in table 4. Lastly, table 5 presents the percentage prediction of total 6 MWT walking distance.

Table 1. Subject Characteristics Based on Age, Height, Body Weight, BMI, Total Distance

Variables	n	Mean (SD)	P value
Age (years)			
- Male	58	26.78 (7.03)	<0.001
- Female	65	21.92 (5.50)	
Height (cm)			
- Male	58	165.47 (6.23)	<0.001
- Female	65	155.22 (4.44)	
Weight (kg)			
- Male	58	58.58 (7.33)	<0.001
- Female	65	52.18 (5.35)	
Body Mass Index (kg/m ²)			
- Male	58	21.34 (1.81)	0.364
- Female	65	21.64 (1.82)	
Total distance (m)			
- Male	58	581.89 (49.41)	<0.001
- Female	65	516.72 (37.40)	

*independent sample t-test

Age of males in the study ranges from 18 to 45 years old, while their female counterpart was 18 to 42 years old. Both groups demonstrated that subject age were still in the range of 18 to 50 years old. Subject Body Mass Index (BMI) was all categorized as normal. Males achieved a walking distance of 581,98 meters, and females on the other hand was 516,72 meters.

Table 2 shows predicted walking distance which was calculated based on Nury's formula, which was a derivation of a linear regression calculation.

Table 2. Predicted Total Distance Based on Gender

Variables	Mean (SD)	p value*
Predicted total walking distance (meter)		
- Male	581.98 (3.81)	<0.01
- Female	516.80 (3.00)	

*independent sample t-test

Table 3. Percentage to Predicted Total Distance Based on Gender

Variables	Mean (SD)	p value*
Percentage to predicted total distance (%)		
- Male	99.98 (8.51)	0.995
- Female	99.98 (7.15)	

*independent sample t-test

Table 3 presents percentage of predicted walking distance based on gender, and there was no significant difference between them.

Table 4. Summary of the Interpretation of Actual Walking Distance of 6MWT

Variables	Criteria (rounded)	Interpretation
Actual walking distance (meter)		
- Male	≥483 m	Normal
- Female	434 m - 483 m	Poor
	<434 m	Very poor
	≥442 m	Normal
	405 m - 442 m	Poor
	<405 m	Very poor

Table 4 presents normal values with ROC. There are three subgroups for each gender.

Cut off point of walking distance was made different for males and females. Both were divided into three subgroups, that is normal, poor, and very poor

Table 5. Percentage to Predicted Total Distance of 6MWT

Variables	Criteria (rounded)	Interpretation
Percentage to predicted total distance (%)		
	≥85%	Normal
	77 % - 85%	Poor
	<77%	Very poor

Normal values were presented based on achieved walking distance and percentage to predicted total distance of 6MWT.

Percentage cut off point to predicted total distance were

not compared to gender, and were categorized into three subgroups, namely normal, poor, and very poor.

Discussion

Aligned with the study aims to obtain cut off point of actual walking distance and percentage to predicted walking distance, the five result tables accommodates those aims. Discussion will then begin with the finding of cut off point for actual walking distance.

Result table 1 showed walking distance as a direct output of 6MWT. The actual walking distance is the foundation of a single measure cut off point in 6MWT. Walking distance were also shown to differ between genders, therefore cut off point were made different for males and females.

Table 1 also had shown variables required to calculate predicted walking distance, utilizing the formula devised in the main study,¹¹ that resulted in predicted walking distance formula (Nury’s formula) as follows: 586,254 + 0,622 BW (kg) – 0,265 BH (cm) – 63,343 gender* + 0,117 age.

Table 2 shows predicted walking distance based on gender. The predicted walking distance was calculated based on predicted walking distance for Indonesian (Mongoloid race).¹¹ The mean predicted walking distance for males was 581,98 meters, while females 516,80 meters. A statistically significant difference were found for these values.

The formation of these cut off points then require percentage walking distance to its prediction. This was shown in table 3, where the percentage to the prediction were displayed for each gender. As a result, 99,98% for both males and females subjects were obtained, and there was no statistically significant difference between them.

Cut off point discussion begins from walking distance, and then percentage of walking distance to its predicted values. Table 4 shows cut off point for walking distance for each gender. The actual walking distance were obtained through 6MWT and was categorized as normal, poor, and very poor. In male subjects, actual walking distance were taken as normal when value is ≥483 meters, poor in 434-483 meters, and very poor < 434 meters. As for female subjects, range was generally lower, normal when ≥442 meters, poor when 405-442 meters, and very poor in distance <405 meters.

Finally, table 5 demonstrates cut off point percentage to its predicted walk distance without gender comparison. The result was then categorized into three subgroups, normal, poor and very poor. Normal percentage was ≥85%, poor when distance is 77-85%, and <77% categorized as very poor.

Singh had only made two groups,¹⁴ while in this study three subgroups were formed, that normal was up until ± 2 SD, poor if between < -2 to -3 SD, and very poor when it’s lower than -3SD. Percentage cut off point to predicted walking distance were also calculated in the same fashion. However, the study results on table 3 had shown that there are no significant difference between genders, and thus there were only one normal values which was also categorized into three

subgroups. This study had also succeeded to formulate cut off point for normal actual walking distance and percentage walking distance to its predicted 6MWT walking distance.

There is no literature that has reported the actual cut off point from the 6MWT in a single measure. Therefore this study could be an initial observation, and further could be made towards gait speed. Percentage cut off point to percentage walking distance to predicted has already been reported by Gosselink to predicted walking distance by Paul Enright. The predicted formula was devised so that a single measurement could be interpreted. Gosselink had only made one cut off point. The value $\pm 85\%$ was mentioned to be of a good value.⁶ In accordance with the recommendation of ATS¹ and previous research reports,^{15,16} they had mentioned that anthropometry plays a significant role in 6MWT, and thus is the origin of Indonesian predicted formula (Mongoloid).

The capability of gait speed in depicting general conditions and predict various clinical outputs had been reported previously.¹⁷ Gait speed as a parameter has been considered as the best,¹⁸ reliable, valid,¹⁹ sensitive,²⁰ and also specific,²¹ as it correlates with functional capacity of an individual.²² The change in functional and psychology could also be reflected by their gait speed. Besides these characteristics, it could also predict future health status.^{23,24} Therefore studies had reported that gait speed could be the “sixth vital sign” for all patients alongside with blood pressure, heart rate, respiratory rate, temperature, and pain.¹⁷

Walking distance is a direct output of 6MWT. The distance achieved in 6 minutes also reflects their gait speed. There has been no agreement on gait speed obtained by 6MWT. ATS protocol used a 30-meter track with vocal cues to assist subject in walking the furthest possible for six minutes, back and forth, as fast as possible, but they were allowed to reduce speed or even rest in cases of dyspnea.¹ This same protocol was adopted by Guyatt,¹⁰ and in Sri Ramachandra University for 6MWT.²⁵

Enright, with older adult subjects had only requested them to walk and achieve their furthest walking distance. At every minute, their guiding technicians were only allowed to give standard comments such as, “Good work, continue”, and not with any other phrases.²⁶

In contrast, Troosters, Gooselink, Decramer, allowed their older healthy adult subjects to walk as fast as possible to achieve their furthest distance. This study uses healthy subjects and recommended them to walk fast, with stable speed, as they are expected to enter a steady state with Borg 12-13, or in healthy persons with heart rate 120x/minute.²⁷

One of the main benefits reported in this study, is to provide an actual 6MWT cut off point which had never been reported and percentage to predicted walking distance. This report is the first report to provide actual walking distance. Whereas percentage to predicted walking distance, Gosselink had only provided one cut off point for Caucasians. The normal values in this study then had provided cut off points,

categorized in three subgroups. Furthermore, the study was also performed in healthy subjects, which goes in accordance to healthy reference values as found in general guidelines.¹²

Healthy subjects in this study were also considered as a limitation, as it was limited to 50 years old, without disorders originating from cardiorespiratory, musculoskeletal, or neuromuscular, thus requires careful observation when used for other age groups. The recorded gait speed was then categorized as fast walking. Six-minute walking test at its application, could be used in the older population,^{28,29} or other subjects with disorders from cardiorespiratory,³⁰⁻³² musculoskeletal,^{33,34} or neuromuscular origins,^{35,36} which obviously had slower walking speed or even intermittent resting periods.

The normal values reported in this study could then be used as a reference value for further studies, and thus could obtain other variable values such as age, gait speed, and afterwards could be the basis of other race research on 6MWT walking distance.

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