FACTORS CORRELATED WITH INCREMENTAL SHUTTLE WALK TEST DISTANCE IN SEDENTARY HEALTHY ADULTS

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ABSTRACT

Background: In carrying out daily activities, it is influenced by a person's physical fitness. A person's functional capacity can be assessed by exercise testing distance. One of the exercise tests that currently being applicated nowadays is incremental shuttle walk test (ISWT). There are various factors that affect cardiorespiratory fitness, as well as demographic and anthropometric characteristics such as age, gender, body height, and body weight. This study focused on demographic and anthropometric factors.
Objective: The aim of this study was to determine the factors that correlate with ISWT distance in sedentary healthy adults
Material and Methods: This study was a cross-sectional study conducted on 85 subjects. Subjects performed ISWT twice, with the greatest distance was included in analysis. The independent variables (age, gender, body height, body weight) were analyzed using bivariate analysis to see the correlation with ISWT distance. Furthermore, multivariate analysis was done to see the most influential variable.
Results: Sixty women were participated in this study. Among four variables, multivariate analysis showed gender, body height, and body weight correlated with ISWT distance ($p<0,05$)
Conclusion: Gender, body height, and body weight correlated with ISWT distance in sedentary healthy adults.
Keywords: Incremental shuttle walk test, distance, sedentary, healthy, field test

BACKGROUND

Physical fitness is needed by us to do our activity daily living. One of the components of physical fitness is cardiorespiratory fitness. Cardiorespiratory fitness was defined as ability to do a dynamic moderate to vigorous intensity exercise that involving big major muscles in long period.(1) Cardiorespiratory fitness is able to depict someone's functional capacity, while functional capacity portrays the ability to do daily activities that requires continues aerobic metabolism. Pulmonary, cardiovascular, and skeletal muscle systems contribute to someone's functional capacity. To measure functional capacity, we can use several parameters such as maximum oxygen uptake (VO2 max), metabolic equivalent of tasks (METs), and walking distance acquired from filed exercise testing.

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How to cite this article :
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The most common filed exercise testing is six minute walking test (6MWT). It is used worldwide in clinical setting. Moreover, another field test that evolving nowadays is incremental shuttle walk test (ISWT). There are several differences in between both tests. First, in ISWT, the subject walks on 10-meters lap with walking speed is increased at every level whereas in 6MWT, subject walks in a constant speed in a-30 meters-lap for 6 minutes. Second, ISWT is guided by an audio, so it is an external-paced test. On the other hand, 6MWT is a self-paced test. It means the subject will be able to determine his/her own walking speed during the test period. Third, no motivation support is given to subject while doing ISWT, so it is expected to portray subject's ability more accurately. And the last, the length of track used in ISWT is 10 meters, shorter than used in 6MWT's track, which is 30 meters. It makes ISWT more applicable in smaller space.[3] The outcome of ISWT is walking distance, defined as the summation of completed levels and shuttles that subject can finished .[2, 3] The distance shows someone's functional capacity. Walking test itself is influenced by walking, and walking process is determined by several factors, as follows age[4], gender[5], body height(6), and body weight[7]. As stated before that field exercise test (including ISWT) can depicts physical fitness. Hence, factors that influence physical fitness or cardiorespiratory fitness are also considered to influence walking process and walking distance. Factors that be able to influence cardiorespiratory fitness, declared as VO_2 max, are humidity[8,9], temperature[10], hemoglobin[11], blood lactate level[12], and also demographic and anthropometry characteristics including age[13, 14], gender[15, 16], body height[17], and body weight[18].

Several studies conducted in several countries got the conclusion that age, gender, body height, and body weight correlated to the ISWT distance.[19-22] However, there is no similar study conducted in Indonesia yet. ISWT itself is not yet familiar in Indonesia. Therefore, focus of this study are these four factors; age, gender, body height, and body weight.

OBJECTIVE

This is a pilot study, aimed to see the correlation between age, gender, body height, body weight and ISWT distance in healthy sedentary adults.

MATERIALS AND METHODS

Participants

This was a cross-sectional study, conducted in Cipto Mangunkusumo Hospital, Jakarta, during February to November 2020. Consecutive sampling was done. Inclusion criteria were 18-59 years old, sedentary subject (assessed using Internasional Physical Activity Questionnaire (IPAQ)), normal mental status (assessed using Montreal Cognitive Asessessment (MoCA-INA)), had good cognition (normal IQ), had good hearing function (assessed using physical examination), had good visual function (assessed using physical examination), no neurology deficit (assessed using physical examination), normal msuckuloskeletal system (manual muscle test score was 5, and full range of motion of extremities) and no balance disorder (assessed using physical examination). Exclusion criteria were someone using ambulatory aid and a smoker. This study had been approved by *Komite Etik Penelitian Kesehatan Fakultas Kedokteran Universitas Indonesia* and all subjects gave written informed consent to participate. Ethical consideration in this study were as follows: obtaining informed consent from the subjects and confidentiality of all obtained information and data.

Incremental Shuttle Walk Test

The ISWT was conducted based on Singh protocol[23], on a 10-m hallway, marked by two cones. The walking speed increase progressively (increase of 0,17 m/s per minute) that was guided by a series of sound.[20] When the subject unable to reach the closest cone (0.5 m from the cone) by the time of the sound, the examiner ended the test. The subject could also end the test for any

reasons (such as dyspnea, leg cramp, etc). The test was performed twice, and the greater distance between two test was selected as test result. The result was the summation of the completed 10-m lap, defined as walking distance.

Equipments

The equipments used in this study were inform consent form, data form, 10-m track, 2 cones, audio tape as guidance of walking speed[20] according to Singh protocol[23], pulse oximetry, sphygmomanometer, stethoscope, Borg scale, oxygen, body weight scale, body height stadiometer, electrocardiography, and Snellen chart. The subject that fulfill inclusion criteria and did not fulfill exclusion criteria got the informed consent. Hereinafter, subject got the explanation about the study and underwent anamnesis and physical examination. Subject did ISWT two times, and the greater distance was selected into analysis.

Statistical analysis

Data were analyzed using SPSS (*Statistical Package for the Social Sciences*) 21.0 version. Normality of data was determined by Kolmogorov-Smirnov and histogram frequency. Bivariate analysis was done to see correlation between independent variable (age, gender, body height, and body weight) and ISWT distances. Furthermore, multivariate analysis was done to see what the most correlated variable was.

RESULTS

Total of subjects in this study was 85 subjects, 60 subjects were female. The subject's characteristic could be seen in table 1. The median of age was 30 years old. Body height and body weight of male were greater than female. The median of ISWT distance was 520 m (330-750 m).

The ISWT distance in male and female could be seen in table 2. The males' distances was greater than females'. The table 3 shows the relationships between age, gender, body height, and body weight with ISWT distance. Gender, body height, and body weight were correlated to ISWT distance.

DISCUSSION

All of the subjects were categorized as young adult. It was differed from Itaki, et al[19] and Agarwal, et al[24] that age range was wider, and Harison, et al. had older subjects[25]. The ISWT distance in this study was shorter than previous study.[19, 24] The reason was there was the discrepancy of anthropometric characteristic among the subjects of each study. Another fact needs to be remembered that this study was conducted in pandemic COVID-19 condition, so that all of the subjects using surgical mask while doing the ISWT. Using of surgical mask can allegedly reduce the cardiopulmonary fitness, lead to decreased walking distance.[26]

Age was not correlated with ISWT distance. Narrower age range, differed from previous studies[19, 24], could be the reason. The pandemic of COVID-19 caused young adults is the most age-range that could attend this study and became the subjects (older subjects prefer to stay at home). Previous study showed that age was correlated with ISWT distance[19, 24], which means older adult had shorter ISWT distance, and vice versa. Older person had lower gait speed and shorter step length compared to the younger person.[4] Older one had lower cardiorespiratory fitness compared to younger.[13] Maximal oxygen uptake (VO_2 max) decreased 5-2-% per decade in healthy individual age 20-65 years old.[14]

Second variable, gender, was correlated to ISWT distance. Male had greater ISWT distance compared to female. It is similar to previous study.[19-22, 24] Male walks with greater speed than female.[6] Furthermore, female had more movement in non-sagittal plane, result in reduced step length.[27] In same range time, male managed to walk longer than female. Another reason was male had greater physical fitness compared to female.[13, 15] In this study, male's body height was greater than female's, leads to male's longer step length[6] and consequently greater ISWT distance.

Body height was correlated to ISWT distance. It was similar to Itaki,et al.[19] and Dourado, et al [20] There was correlation between body height and stride length. Someone that has greater body height will has longer stride length,[6] leads to greater ISWT distance. Lastly, body weight, was correlated to ISWT distance. It was also similar to former study. Obese and overweight female was correlated to lower gait speed.[7] Overweight and obese person had greater load in knee joint, lead to knee pain and moreover, to shorter step length and reduced gait speed.[28] Furthermore, increased adipose tissue in obese person changes lean mass ratio dan impair skeletal muscle function, consequently reduce gait speed.[29] The reduced gait speed causes shorter ISWT distance, as could be seen in this study that someone had greater body weight also had shorter ISWT distance.

Multivariate analysis showed gender and body weight were most correlated factor to ISWT distance. This study had r^2 0.442, means that gender, body weight, and body height can explain 44.2% variance of ISWT distance in healthy sedentary young adult. The variance was lower than Itaki et al.[19] and Dourado et al.[20] Therefore, further study involving other variables besides four variables analyzed in this study, needs to be conducted. The results of this study can be used as basic data for advance study about ISWT in Indonesia.

LIMITATION

This study was conducted in early pandemic of COVID-19. Therefore, some technical adjustments were applied such as wearing surgical mask while walking and cancelled spiromery using to assess subjects' respiratory status according to American Thoracic Society (ATS) recommendation. Health status was only assessed by anamnesis and physical examination. Early pandemic of COVID-19 made subjects considered to come to the hospital to do the tests due to fear of COVID-19 infection, especially elderly. In consequence, the majority of subject was young adult.

CONCLUSION

Gender, body height, and body height were correlated to ISWT distance in healthy sedentary adults. Moreover, gender and body weight were the most correlated factors.

CONFLICT OF INTEREST AND SOURCE OF FUNDING

No conflict of interest and no funding in this study

ACKNOWLEDGEMENTS

We are grateful for the contribution of the adults who participated in this study

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Table 1. Subject's characteristic

Characteristic	n (%)	*Mean* ± SD	Median (min-mx)
Age (years)		30,56 ± 2,99	30 (23-38)
Male		30,48 ± 2,60	30 (26-37)
Female		30,60 ± 3,16	30,5 (23-38)
Gender			
Male	25 (29,4%)		
Female	60 (70,6%)		
Body height (cm)		162,18 ± 9,05	160 (148-188)
Male		172,66 ± 7,15	172 (158-188)
Female		157,81 ± 5,48	157,75 (148-177)
Body height (kg)		62,81 ± 14,87	60 (38-119)
Male		76 ± 15,95	70 (56-119)
Female		57,32 ± 10,36	56,75 (38-103)
Level of education			
Bachelor	85 (100%)		

Table 2. ISWT distance

Variable	Mean ± SD	Median (min-max)	p *value*
ISWT distance (m)	535,53 ± 94,88	520 (330-750)	
Male	618 ± 80,20	630 (440-750)	< 0,001*
Female	501,17 ± 78,22	500 (330-710)	

Table 3. Relationships between age, gender, body height, and body weight with incremental shuttle walk distance.

Variable	R	p *value*
Age	-3,147	0,239
Gender	-113,419	<0,001
Body height	3,781	0,013
Body weight	-2,842	< 0,001

r^2 = 0,442