The first reference equations for the 6-minute walk distance over a 10 m course

ABSTRACT

Rationale As primary care practice space is mostly limited to 10 m, the 6-minute walk test (6MWT) over a 10 m course is a frequently used alternative to evaluate patients' performance in COPD. Considering that course length significantly affects distance walked in 6 minutes (6MWD), this study aims to develop appropriate reference equations for the 10 m 6MWT.

Methods 181 healthy subjects, aged 40–90 years, performed two standardised 6MWTs over a straight 10 m course in a cross-sectional study.

Results Average distance achieved was 578±108 m and differed between males and females (p<0.001). Resulting sex-specific reference equations from multiple regression analysis included age, body mass index and change in heart rate, explaining 62% of the variance in 6MWD for males and 71% for females.

Conclusions The presented reference equations are the first to evaluate 6MWD over a 10 m course and expand the usefulness of the 6MWT.

The 6-minute walk test (6MWT) is used to evaluate functional exercise capacity in patients with COPD.[1] Reference equations for the 6MWT were established over courses ranging from 20 to 50 m,[2] with 30 m being the recommended length by the American Thoracic Society (ATS).[1] However, space limitations in primary care force professionals to execute the 6MWT over a 10 m course. Until now, no matching reference equations were established while current studies revealed a significant impact of course length on 6-minute walk distance (6MWD) and risk of clinical interpretation errors.[2 3] We aimed to develop reference equations for the 10 m 6MWT.

A total of 184 healthy Caucasian subjects were recruited. After health screening, 181 remained. Subjects' characteristics are summarised in online supplementary table S1 and S2. 6MWTs were performed in accordance with the ATS guidelines over a 10 m course.[1] Univariate Pearson correlation coefficients and hierarchical/stepwise multiple regression analysis were used to evaluate variables explaining the variance in the 6MWD and to create a model predicting 6MWD. Included variables were sex, age, height, weight, body mass index, FVC, expiratory volume in one-second (FEV1), smoking pack-years, physical activity level, baseline heart rate (HR), change HR, baseline transcutaneous oxygen saturation (SpO_2), change SpO_2, baseline dyspnoea, change dyspnoea, baseline fatigue and change fatigue. A sex-specific lower limit of normal was calculated. Detailed information on methods is available in the online supplement.

We found that 6MWD in male and female was respectively 625±120 m and 554±94 m, with a significant difference (p<0.0001). 6MWD was significantly independently correlated with age, height, body mass index (BMI), FVC, FEV1, smoking, physical activity and changes in HR, experienced dyspnoea and fatigue (see online supplementary table S3). Based on a clear difference between the directions of the slopes for male versus female (see online supplementary figure S1), sex-specific reference equations were calculated (table 1). The amount of variation in 6MWD that was accounted for by the basic and extended model was respectively 52% and 62% for male and 59% and 71% for female. Assumptions of multiple regression analysis were met, and the models appeared to be reliable. Additional information on statistical analyses is available in the online supplement.

Our data provide healthcare professionals with suitable reference equations for the 10 m 6MWT. The significant association of 6MWD with age, gender and either BMI or 'weight and height' corresponds with previous studies.[4] This is the first study to show a significant contribution of absolute HR values. However, HR is not always an adequate predictor for 6MWD due to lack of submaximal cardiac performance, other reasons for performance limitation, deviation of standardised HR measurement or use of β-adrenergic blocking agents. Although both models explained more variance than previous studies with Caucasian subjects (ranging from r^2=0.20 to 0.66)[2], other variables, such as psychological characteristics, may improve explained variance in 6MWD.[4] Elaboration on the discussion is available in the online supplement. We conclude that unique reference equations for the 6MWT are essential when professionals use a 10 m course. The presented equations solve a practical problem and apply to subjects in various healthcare settings.

Table 1 Reference equations for 6MWD over a 10 m course

Basic equation	
♂ 6MWD = 1266 − (7.80*age) − (5.92*BMI)	r^2 = 0.52
LLN = 6MWDpredicted − 163	r^2 = 0.59
♀ 6MWD = 1064 − (5.28*age) − (6.55*BMI)	
LLN = 6MWDpredicted − 119	
Extended equation*	
♂ 6MWD = 1073 − (6.03*age) − (5.79*BMI) + (1.86*HRchange)	r^2 = 0.62
LLN = 6MWDpredicted − 146	r^2 = 0.71
♀ 6MWD = 878 − (3.60*age) − (6.42*BMI) + (1.95*HRchange)	
LLN = 6MWDpredicted − 101	

*The choice whether the extended model can be used should depend on the considerations of the healthcare provider.
6MWD, 6-minute walk distance in m; age in years; BMI, body mass index in kg/m^2; HRchange, change in heart rate in beats per minute (heart rate measured directly after the test minus heart rate measured at rest before the test); LLN, lower limit of normal; r^2, the coefficient of determination, the proportion of variability in a dataset that is accounted for by a statistical model.

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