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ORIGINAL ARTICLE

6-Min walk-test data in healthy North-African subjects aged 16–40 years

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KEYWORDS

6-Min walk-distance;
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Abstract *Background:* In North-African and Mediterranean countries (such as Algeria, Tunisia, Morocco, Libya) no local 6-Min walk-distance (6MWD) norms exist for subjects aged 16–40 years.

Aims: (i) To test the applicability and reliability of the previously published norms for Arab or Mediterranean subjects aged ⩾ 16 years in this population and, if required, (ii) to establish a 6MWD reference equation for use in North-African subjects aged 16–40 years and prospectively assess its reliability and to propose a clear scheme to interpret the measured 6MWD.

Study design: Prospective cross-sectional study.

Methods: Metabolic-equivalent-task (MET) walking, moderate, and vigorous activities, anthropometric, spirometric and 6-Min walk-test (6MWD, heart-rate, oxy-haemoglobin-saturation) data were measured/noted in 200 healthy Algerian subjects aged 16–40 years (100 women). Univariate and multiple linear regression analyses were used to find-out 6MWD influencing factors, reference equation and to determine the lower-limit-of-normal (LLN).

Abbreviations: ATS, American-Thoracic-Society; BMI, body-mass-index; COPD, chronic-obstructive-pulmonary-disease; DBP, diastolic-blood-pressure; ERS, European-Respiratory-Society; FEV_1, first-second-expiratory-volume; FFM, fat-free-mass; FVC, forced-vital-capacity; Hr, heart-rate; IPAQ, international-physical-activity-questionnaire; LAOVD, large-airways-ventilatory-obstructive-defect; LLN, lower-limit-of-normal; MET, metabolic-equivalent-task; mHr, predicted-maximal-heart-rate; MMEF, maximal-mid-expiratory-flow; Oxy-sat, oxy-haemoglobin-saturation; r, correlation-coefficient; r^2, determination-coefficient; RSD, residual-standard-deviation; SBP, systolic-blood-pressure; SD, standard-deviation; TRVD, tendency-to-a-restrictive-ventilatory-defect; ΔHr, $Hr_{end\text{-}rest}$; 6MWD, 6-min walk-distance; 6MWT, 6-min walk-test; 95%CI, 95% confidence-interval; end, at the end of the 6MWT; rest, before the 6MWT

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Results: The mean ± SD of 200 included subjects' age, height, weight, body-mass-index (BMI), lean-mass, first-second-forced-expiratory-volume (FEV_1) and MET moderate activity were, respectively, 27.5 ± 6.7 years, 169 ± 9 cm, 69.3 ± 11.5 kg, 24.1 ± 3.6 kg/m^2, 16.7 ± 7.4 kg, 3.70 ± 0.74 L and 370 ± 686 min/week. Their 6MWD mean ± SD (minimum–maximum) was 680 ± 70 (540–888) m. The published norms for Italian and Saudi-Arabian populations did not reliably predict measured 6MWD. The following 6MWD influencing factors were noted: FEV_1, BMI, sex, lean-mass, MET moderate activity and age ($p < 0.001$). A reference equation, explaining 58.7% of the 6MWD variability, was established: 6MWD (m) = 800.05 + 64.71 × Sex (men:1/women:0) − 10.23 × BMI (kg/m^2) − 1.63 × Age (years) + 2.05 × Weight (kg). To calculate the 6MWD LLN subtract 74.31 m from the predicted value. In a second group of 39 young subjects (19 women) prospectively studied to validate the reference equation, the agreement between the measured and predicted 6MWDs was adequate.

Conclusion: This reliable 6MWD norm is helpful for the care of North-African patients aged 16–40 years.

Introduction

Exercise testing is increasingly utilized in clinical practice to optimize patient management and acquire useful functional and predictive information not accessible through static cardiopulmonary tests, such as spirometry and/or electrocardiogram [1–5]. Among the available variety of exercise testing protocols for this purpose; the 6-Min walk-test (6MWT) is an inexpensive and expeditious test of functional ability [1–4]. It is a self-based walking test that measures the distance walked over a 6-Min period (6MWD) [1,3]. It is frequently used to evaluate exercise capacity in patients with chronic diseases [2–4,6–8]. The interpretation of this test, which is more wistful of daily living activities than other walk tests [1–3], relies on the comparison of measured 6MWD with the normal predicted value from reference equations or norms [1,2,9–36].

Normal predicted values for 6MWD are often based on sex and anthropometric data (eg, age, height and weight) [1,4] and the influence of race and/or ethnicity is still ambiguous [1,18]. At the best of the authors knowledge, only three 6MWD norms were published for healthy Arab "adults" populations [9–11]; two for Tunisians older than 40 years [9,10] and one for Saudi aged 16–50 years [11]. In addition, among all published studies aiming to establish 6MWD norms in healthy adults [9–36] only one included young Mediterranean ones; Italians aged 20–50 years [12]. In North-African Mediterranean countries (such as Algeria, Tunisia, Morocco, Libya) no local 6MWD norms existed for subjects aged 16–40 years and norms derived from Arab [11] or Mediterranean [12] populations are commonly used. This was the case of two recent studies aiming to evaluate the functional capacity of exclusive-narghile-smokers [7] and obstructive-sleep-apnoea-hypopnea-syndrome patients [8]. This is a problematic practice, since the applicability and trustworthiness of these norms has never been verified in the local population, even though several specificities have been noted concerning ethnic background, anthropometric data, physical activity status, etc. [37]. The use of these 6MWD norms [11,12] may lead to invalid clinical analysis of 6MWT data [4,10,26]. In a multicenter study, the 6MWD norms varied in function of the geographic site; therefore, different countries need specific equations [26]. Moreover, the answer to the question of which 6MWT norm should be used in chronic-obstructive-pulmonary-disease (COPD) patients, was that the choice should be specific for the country/region of origin [38]. Furthermore, the American-Thoracic-Society/European-Respiratory-Society (ATS/ERS) promote investigators to publish norms for healthy persons using the 6MWT guidelines [1,3].

Although physical inactivity may lead to increased risk of long-term disability and co-morbidity [24,39], the relationship between the physical activity status and the 6MWD of healthy subjects is controversial [10,11,14–16,24–26,30,31,33]. In some studies [10,14], it was shown to correlate, albeit poorly, with the 6MWD. Other studies [11,15,16,25,30,31,33] found no significant correlations between the 6MWD and physical activity status evaluated by several ways [40–43]. In addition, in the study [24] applying the international-physical-activity-questionnaire (IPAQ-8) [44], no data were reported about the relationship between measured 6MWD and physical activity levels'.

Yet, lean-mass is a predictor of exercise capacity in healthy subjects [45], and at the best of the authors knowledge, no study aiming to establish norms in healthy subjects aged ⩾ 16 years [9–36] has evaluated its relationship with measured 6MWD. This is a further criticism, because the classical measured anthropometric data may not cover all the important anthropometric information that may be required to explain 6MWD variability'. In COPD, 6MWD was similar in patients with and without lean-mass depletion, indicating that the skeletal muscle has limited influence on 6MWD [46]. Specific studies on the influence of lean-mass on 6MWD of healthy adults are needed,

Making a medical judgment is an art, where test results help to confirm or decline the diagnosis [47]. A test result is regarded as well-matched with disease if it is outer to the normal range [47]. In young subjects, the last can be determined by three methods: tables of reference centile by age-decade [23], calculating the lower-limit-of-normal (LLN) [14,19,20,22,24] or fixing a percentage (81% of predicted value [15]) below which the 6MWD is considered abnormal. In some studies [13,16–18,21], especially the Saudi and the Mediterranean ones [11,12], no interpreting scheme was proposed.