Review Article

Six-Minute Walk Test as a Guide for Walking Prescription for Patients with Chronic Obstructive Pulmonary Diseases

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Abstract

Exercise training in chronic respiratory disorders such as chronic obstructive pulmonary disease (COPD) is an essential component of pulmonary rehabilitation, but physical activity for maintenance of benefits in COPD after outpatient/inpatient rehabilitation is a neglected one. The dosage of walking is not "prescribed" properly by health-care providers for maintenance of muscle mass and improving quality of life. If the ground or treadmill walking is appropriately dosed and prescribed based on 6-min walk test (6MWT), the unsupervised ground walking may be a useful alternative to supervised aerobic fitness programs for achieving fitness benefits. This article provides an overview of dosing and measuring the walking program (either ground or treadmill) objectively to novice therapists and primary care physicians based on the 6MWT to COPD patients.

Keywords: Benefits, ground walk, prescription, six-minute walk distance, six-minute walk test, treadmill walk

Introduction

Exercise intolerance and poor quality of life are commonly addressed issues in chronic obstructive pulmonary disease (COPD).[1] Exercise-based pulmonary rehabilitation improves exercise tolerance and functional capacity, thereby improving occupational work tolerance and quality of life in COPD individuals.[2] Walking is commonly prescribed in primary care to enhance exercise tolerance and maintenance of quality of life in COPD individuals with moderate-to-severe GOLD criteria.[1] However, the compliance is poor.[3] Adequately dosed walking improves functional capacity and quality of life in COPD patients.

The walk training is suggested in an unstructured (nearly placebo) and nonsystematic manner such as "every day at least 30 min" in people with chronic respiratory disorders.[4] There is a chance of overdosing or underdosing the walk training at the primary care or public health-care level if walking is prescribed nonsystematically. The method of target heart rate is impractical or not feasible at the public health level or fundamental clinical level or for a home prescription.[5]

Six-minute walk test (6MWT) is a simple, reliable test used for the measurement of functional capacity in a variety of chronic lung disorders.[6] For quantification of intervention effects and disease progression, 6MWT is proven to be a handy measure justified by the overwhelming current literature.[7] However, its usefulness in the prescription of walking (aerobic activity) is little known. The aim of the present review is to provide clinicians/therapists with basic understanding of 6-min walk distance (6MWD) calculation and exercise prescription based on it. Further, it may provide a comprehensive knowledge on basic and advanced outcome measures of 6MWT.

Six-minute walk test

6MWT is a self-paced submaximal field exercise test employed for determining the functional capacity, disease intensity, and disease progression of the patients with COPD.[7] The variability of 6MWT depends on the anthropometric traits, physical activity of the individual, racial, cross-cultural differences, motivation, altitude, humidity, clothing, and timing of the test.[8] Its standardization has been elaborately discussed in the previous literature for ensuring the validity and reliability of 6MWT.[8,9] The outcome measures monitored

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by the 6MWT are actual 6MWD, predicted or ideal 6MWD percentage from normative data, and 6MWD percentage.[10] Vitals (pressure changes, desaturation, and heart rate variation) and distance-weight product (6MWD×BW) are also useful outcomes in 6MWT.[11] The primary outcome measure that is used widely in the available literature for calculating walk intensity is the distance walked (6MWD).[9,11]

Procedure and instructions of six-minute walk test

6MWT is standardized well by the American Thoracic Society (ATS) and the American Association for Respiratory Care.[9] 6MWT is administered in the 30 m hallway with cones at the end. The patients are instructed to cover the maximal distance in 6 min (not as fast as possible). The encouragement during 6MWT is also standardized because the former is found to be influencing the walk distance of the patient.[12] The environment should be calm and accessible to resuscitation. 6MWT should be administered individually not as a group because the competition may increase the walk distance falsely.

Calculation of walk intensity and progression from actual six-minute walk distance

Recently, exercise prescription based on 6MWD has acquired a significant interest in chronic respiratory disorders.[13,14] The existing evidence, however, is complicated by deriving maximal oxygen consumption from the predicted equations which is proved to be less reliable and requires expertise.[15] The following method of target walking distance or speed calculation is much more straightforward and requires less skill.

Usually, 80%–90% of the speed in actual 6MWT is assigned an initial speed of walk training either in ground or treadmill.[13] The ideal duration is 15–20 min of walk. If the patients are very debilitated, the walk period can be split up into healthy levels of walk duration (5-5–5 or 6-6–8 min termed interval training). The walk training may be carried at the pace of 80% of actual 6MWT speed at the 1st week of walking, 90% of 6MWT speed during the 2nd week, and 100% of 6MWT speed while following the 3rd week. Then, the actual 6MWD is reassessed (appraised), and the walk training shall be based on 80%–100% of new 6MWT speed. Thus, walk training should be progressed by the swiftness of the appraised 6MWT every 3 weeks. The speed is to be maintained at a minimum duration of 15 min excluding warm-up and cool down walk at a slower pace.

$$\text{actual 6 MWT speed} = \frac{\text{actual 6 MWD}}{100}\ \text{km/h}$$

$$\text{walk training speed} = \frac{\text{actual 6 MWD}}{100}\ \text{km/h}$$

$$\text{walk training speed at 1}^{\text{st}}\ \text{week} = \frac{80}{100} \times \text{actual 6 MWD speed}$$

$$\text{walk training speed at 2}^{\text{st}}\ \text{week} = \frac{90}{100} \times \text{actual 6 MWD speed}$$

$$\text{walk training speed at 3}^{\text{rd}}\ \text{week} = \text{actual 6 MWD speed}$$

Once the walk training speed is completed at the pace of actual 6-min walk speed for 20 min, the newer 6MWD may be measured, and walk training speed can be calculated by it for the following 3 weeks. For treadmill walk training, this walking speed above and duration parameters can be applied efficiently. Remember, the inclination is to be set at 0° for using the above formula. If inclination in a treadmill is present, then the above calculation will underestimate the patient's walking capacity.

Ground walk training prescription

Ground walking is preferred by patients and physicians because it is functional, simple, inexpensive, and readily applicable.[16] To make ground walking to be useful for reaping the health benefits, the application of exercise training principles (frequency, intensity, and duration) in ground walk training also is a must. The walk speed or intensity of ground walk training is calculated as follows:

Maximum distance that may be walked in 20 min (meters) (20MWD) = actual 6MWD × 3.33 m

Initial training distance to be walked in 20 min at 1st week = $\frac{80}{100} \times$ 20MWD m

Followup training distance to be walked in 20 min at 2nd week = $\frac{90}{100} \times$ 20MWD m

Final training distance to be walked in 20 min at 3rd week = 20MWD m

After 3 weeks of field walk training, new 6MWT is to be employed and new 6MWD to be sought out. From there, new 20MWD may be calculated, and walk training for next 3 weeks at 80%, 90%, and 100% of new 20MWD may be administered for progression. The ground walking is to be managed for at least 5 days a week interspersed with minimal strengthening exercises for large strap muscles (quadriceps and latissimus) for attaining maximal benefit out of the training.

The simulated cases are presented below for better understanding:

Case 1

A retired teacher, a known case of stable COPD (not exacerbated for at least 4 months of physicians' visit) was referred for rehabilitation. Initial 6MWT revealed a 6MWD of 360 m (67% predicted maximal distance). He lives at a place inaccessible to pulmonary rehabilitation. He has a personal motorized treadmill. Chart a treadmill walking program based on the 6MWT. The devising of walk program will be as follows:

Actual 6MWD patient walked = 360 m

Actual 6MWT speed (maximum speed) = (actual 6MWD)/100 km/h = 360/100 = 3.6 km/h

Treadmill walk training speed at 1st week = 80/100 × actual 6MWD speed = 80/100 × 3.6 = 2.9 km/h for 15–20 min.

The warm-up and cool down speed maybe 2.5 km/h for 2 min each for 1st-week walk training.

Treadmill walk training speed at 2nd week = 90/100 × actual 6MWD speed = 90/100 × 3.6 = 3.3 km/h for 15–20 min.

The warm-up and cool down rate maybe 2.5 km/h for 2 min each for 2nd-week walk training.

Treadmill walk training speed at 3rd week = actual 6MWD speed = 3.6 km/h for 15–20 min.

The warm-up and cool down rate maybe 3 km/h for 2 min each for 3rd-week walk training.

Progression

A new 6MWT may be employed at the end of the 3rd week of the walk training. The resultant 6MWD may be used to plot new walk training regimen as 80%, 90%, and 100% of resultant new 6MWD for the next 1st, 2nd, and 3rd week, respectively, for 20 min.

Case 2

A rickshaw puller known case of stable COPD (not exacerbated for at least 4 months of physicians' visit) was referred for rehabilitation. He could not afford to get a treadmill or join outpatient pulmonary rehabilitation. Initial 6MWT revealed a 6MWD of 360 m (67% predicted maximal distance). Chart, a ground walking program, based on the 6MWT. The devising of walk program will be as follows:

Actual 6MWD patient walked = 360 m

Maximal distance that may be ground walked in 20 min (meters) (20MWD) = actual 6MWD × 3.33 m = 360 × 3.33 m = 1200 m

Initial ground distance to be walked in 20 min at 1st week = 80/100 × 20 MWD m = 80/100 × 1200 = 960 m in 20 min ≈ 1 km in 20 min

Followup training distance to be walked in 20 min at 2nd week = 90/100 × 20MWD m = 90/100 × 1200 = 1080 m in 20 min ≈ 1.1 km in 20 min

Final training distance to be walked in 20 min at 3rd week = 20MWD meters = 1200 m in 20 min ≈ 1.2 km in 20 min

Progression

A new 6MWT may be administered at the end of the 3rd week of the ground walk training. The resultant 6MWD may be used to plot new walk training regimen as 80%, 90%, and 100% of resultant new 6MWD for the next 1st, 2nd, and 3rd week, respectively, for 20 min.

Outcome Measures to be Used in Walk Training Assessment

Six-minute walk distance

Maximal distance covered in 6 min. Although literature claims its variability, the validity and reliability of 6MWD have proved to be useful.[17,18] A clinical difference of 47–54 m is tested to be the best distance gain after intervention (responsiveness) in community dwellers and patients.[19] 6MWD is also useful in monitoring disease progression. Further, 6MWD <350 m is associated with higher mortality rates in participants.[20]

Predicted ideal walk distance and percent predicted distance

At present, there is a growing proportion of interest in the determination of country-specific reference values for identifying age, height, weight, and gender predicted ideal walk distance.[9,21] On the comparison between actual and ideal 6MWD (percent predicted distance), the lag of the patient's ability behind their healthy peers can easily be made. This can be used for measurement and prognosis of the treatment purpose also.[21]

Six-minute walk work

The 6-min walk work (6MWW) is calculated by body weight.[22] 6MWW = actual 6MWD × body weight. Overweight, sleep apnea, and geriatric individuals can track their improvement in the body weight regulation by indirectly measuring 6MWW. However, the normative values are yet to be studied.

Six-minute walk pulse

Probably, this may be a new determinant of autonomic impact on the functional walk capacity. 6MWP = actual 6MWD × pulse rate during peak walk (rate/minute). 6MWP may indirectly determine the sympathetic withdrawal or parasympathetic supremacy after walk training.[23] The normative values are yet to be studied.

Desaturation index

This may be a new index for monitoring desaturation in cardiopulmonary and vascular disorder individuals. Desaturation index may be indicated as

$$DI = \frac{Actual\ 6MWD}{(\Delta\ walk\ saturation)}$$

$$= \frac{Actual\ 6MWD}{(Peak\ walk\ saturation - resting\ saturation)}$$

Safety Concerns

6MWT is easy to use but not without minimal risks such as dyspnea, angina, leg fatigue, and claudication.[9,24] According to the ATS criteria, the safety of 6MWT can be enhanced by appropriate environment accessible to resuscitation, oxygen supplementation, and first aid. Further, the presence of a physician is not mandatory since it is not a maximal exercise testing but requires the presence of exercise professional with current certification in basic life support and exercise testing.[9]

Conclusion

An attempt has been made to quantify ground or treadmill walk intensity based on 6MWD. This may be simple to apply, quantify, improve, and appraise the effects of walking in community-dwelling individuals and patients. This may guide the physicians and novice therapists appropriately for

the walking exercise prescription in community dwellers and COPD where sophisticated exercise programs are in shortage.

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Conflicts of interest

There are no conflicts of interest.

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