The feasibility of a home-based exercise intervention for the improvement of aerobic function in young cystic fibrosis patients

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INTRODUCTION

- Exercise training is seen as an essential tool in the management of cystic fibrosis (CF)[1].
- However, no formal exercise guidelines exist and therefore, prescription of exercise training is under-utilised.
- As exercise is not always possible or practical in the clinical environment, utilisation of the home environment is an important consideration.
- Exercise training in the home environment has been shown to have limited improvements in adult patients[2] and exercise training has been shown to have some benefits in children[3], with the strongest results seen in a clinical setting.
- However, it is unclear what effect a home-based, mixed aerobic and resistance training programme may have in children with mild-to-moderate CF.

CYSTIC FIBROSIS

- Cystic fibrosis is a genetically inherited, life-shortening disease.
- There is **no cure**.
- It is caused by a mutation in the CFTR gene which results in abnormal ion and water transport in and out of the cell.
- This results in a thick, sticky mucus that clogs the airways and digestive tract.
- Approximately 10'000 people in the United Kingdom have CF.
- Median survival age is 43.5 years[4].

AIM

To assess the **feasibility** of a three-month home-based exercise intervention programme in improving exercise capacity in children with mild-to-moderate CF.

METHODS

Three children (2 females; 11.1 ± 0.6 y; 139.2 ±7.3 cm; 33.2 ±0.6 kg) with mild-to-moderate CF (FVC: 81.0 ± 8.9 %; FEV_1: 89.8 ± 10.3 %) were recruited from the Royal Devon & Exeter NHS Foundation Trust Hospital. Ethics approval was granted by the local NHS Research Ethics Committee.

Variables of Interest

- Anthropometric measurements included **height**, **mass** and **BMI**.
- Lung function was assessed with a hand held spirometer, with **FVC** and **FEV_1** values normalised[5].
- Cardiopulmonary fitness (VO_{2max}) was assessed by a combined ramp incremental and supra-maximal cycling test to exhaustion[6]. Gaseous exchange was measured breath-by-breath and values for **VO_2, VCO_2, V_E, Heart Rate** and **RER** were obtained.
- Physical activity was objectively assessed using a triaxial GENEA accelerometer mounted on the wrist over four days (two weekdays). Time spent in **MVPA** (moderate-vigorous activity) and **sedentary time** were collected in absolute and relative terms.
- Subjective exercise tolerance was recorded by way of ratings of perceived exertion (**RPE**) and ratings of perceived dyspnoea **(RPD).**

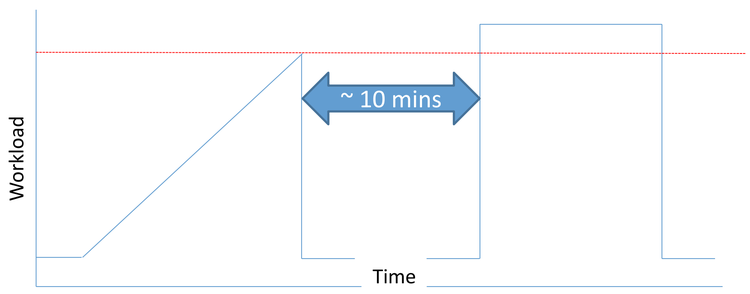

Fig 1. Cardiopulmonary exercise test protocol, as described by Barker *et* al. (2011)

Training Programme

Each patient was assigned a mixed aerobic (AER) and resistance (RES) programme, to take place over a three month period. Participants were allowed free choice in activity selection, but were required to work within a specified HR training zone, based upon initial exercise capacity tests.

- **Weeks 1-4:** AER; 2/week for 45 minutes at 80% GET. RES; None.
- **Weeks 5-6:** AER; 3/week for 45 minutes at 40%Δ. RES; chest, arms, back – 10 reps x 2 with theraband
- **Weeks 7-8:** AER; 3/week for 60 minutes at 40%Δ. RES; chest, arms, back – 10 reps x2 with theraband
- **Weeks 9-12:** AER; 3/week for 60 minutes at 60%Δ. RES; chest, arms, back – 20 reps x 2 with theraband

Researchers maintained contact with patients on a weekly basis to assess progress and ensure compliance.

RESULTS

Cardiopulmonary Fitness:

- Changes in absolute and relative VO_{2max} were observed between pre- (mean ± SD; 1.27 ± 0.13 $L \cdot min^{-1}$; 38.07 ± 4.41 $ml \cdot kg^{-1} \cdot min^{-1}$) and post-training (1.19 ± 0.16; 35.86 ± 6.01).
- The gas exchange threshold increased in absolute terms (0.66 ± 0.12 to 0.72 ± 0.11 $L \cdot min^{-1}$) and as a percentage of VO_{2max} (52.3 ± 6.9 to 60.5 ± 0.9 %).

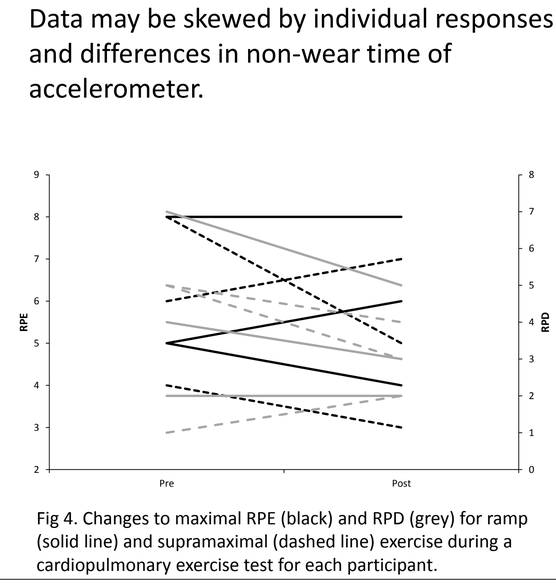

Fig 2. Changes in maximal cardiopulmonary fitness (solid line) and the gas exchange threshold (dashed line) for each participant.

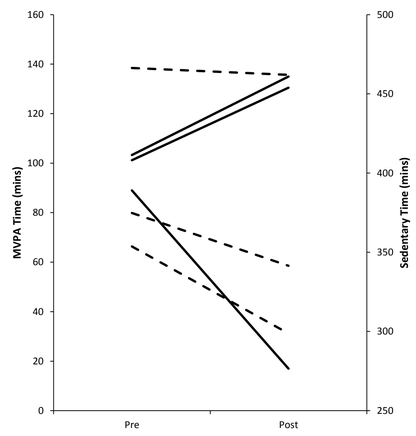

Fig 3. Changes to moderate to vigorous physical activity (solid line) and sedentary time (dashed line) for each participant.

Physical Activity:

- The duration of sedentary time decreased by 30.9 ± 25.4 minutes following training (- 1.15 ±13.10 %).
- Light activity increased by 8.3 ±82.1 minutes (+ 2.18 ± 4.48 %).
- MVPA decreased by 3.7 ± 59.2 minutes (-1.33 ± 8.35 %).
- Data may be skewed by individual responses and differences in non-wear time of accelerometer.

Exercise Tolerance:

- RPE showed little change in ramp (6 ± 2 – 6 ± 2) or supramaximal (6 ± 2 – 5 ± 2) exercise.
- RPD decreased in both ramp (4 ± 3 – 3 ± 2) and supramaximal (4 ± 2 – 3 ± 1) exercise .
- Considered alongside changes in relative peak power (2.82 ± 0.42 – 2.92 ± 0.26 $W \cdot kg^{-1}$), increased tolerance is suggested.

Fig 4. Changes to maximal RPE (black) and RPD (grey) for ramp (solid line) and supramaximal (dashed line) exercise during a cardiopulmonary exercise test for each participant.

CONCLUSIONS

The results of this feasibility study suggest:

- Home-based exercise is a feasible modality of exercise training in children
- A mixed aerobic and resistance programme can improve exercise capacity, exercise tolerance and physical activity
- Compliance is difficult to ensure and may explain large variances in results

The current methods and results will be utilised to inform future randomised control trials in CF

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