accelerometer use) were evaluated. All parents signed the informed consent form. Spearman test for correlations, Student's t test and the Mann-Whitney test for comparisons, and a multivariate linear regression model were used.
Results: Thirty-one patients (20 girls) with a median age of 9.6 years and FEV_1 (%) of 68.1 ± 24.4 were included. Obstructive sleep apnea syndrome (OSAS) was present in 10 participants (32.3%) and nocturnal hypoxemia was identified in 9 (29%). The distance achieved in the MST correlated with the average SpO_2 during sleep (r = 0.40) and the percent of total sleep time with SpO_2<90% (r = –0.49). In addition, the SpO_2 at the end of the MST correlated with the occurrence of OSAS (r = –0.48) and mean nocturnal SpO_2 (r = 0.45). On the other hand, the levels of daily physical activity correlated with sleep architecture, including the percent of stage II (r = 0.50) and REM stage sleep (r = –0.47). Patients with OSAS and nocturnal hypoxemia presented lower values ($p < 0.05$) of distance and final SpO_2 in the MST when compared to individuals without these alterations. Nocturnal hypoxemia was the main variable to influence exercise capacity ($r^2 = 0.521$).
Conclusion: Sleep disorders are distinctively related with exercise capacity and daily physical activity levels, as nocturnal hypoxemia is associated with exercise intolerance and sleep architecture disorders are associated with sedentary physical activity levels.

ePS1.04
Effects of exercise with neuromuscular electrical stimulation on peripheral muscle strength, lung function and aerobic fitness in patients with cystic fibrosis: a randomised controlled trial
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Objectives: To investigate whether the addition of neuromuscular electrical stimulation (ES) to an exercise program results in improvements in peripheral muscle strength, lung function and aerobic fitness.
Methods: A randomised controlled trial was performed on children aged between 6 and 18 years. Patients were randomised to one of the following groups: Control (CON) - standard exercise recommendations from the cystic fibrosis (CF) team (n = 11); Exercise (E) - supervised resistance exercise (n = 8); and Exercise+ES (EES) - supervised resistance exercise using ES (n = 6). Both exercise programs were performed 3 times a week (8 weeks). ES was used in lower limbs and posterior trunk muscles. Muscle strength, lung function and aerobic fitness were evaluated before (T1) and after (T2) the interventions. Repeated measures ANOVA followed by the Bonferroni post-test was used (significance at $p \leq 0.05$).
Results: Twenty-five patients with CF (20 boys) were included in the study with a mean age of 12.7 ± 2.9 years and mean FEV_1 was –1.5 ± 1.5 (z score). No significant difference in both body weight and lung function was found. However, a significant increase in VO_2 (% of max) at anaerobic threshold (AT) was noted in the EES, while a decrease was seen in the CON. The mean VO_2 (% of max) was 59.6 ± 14.9 vs 68.9 ± 10.8 ($p = 0.05$) in the EES group and 71.8 ± 12.3 vs 62.1 ± 11.6 ($p = 0.01$) in the CON group. A significant interaction between groups and time was found for leg press strength ($p = 0.003$), bench press strength ($p = 0.001$) and seated row strength ($p = 0.001$). Both E and EES groups, but not CON, increased leg and bench press strength after the 8-week program. As for seated row strength, all groups showed an increase on T2, although the use of ES induced a higher improvement as compared to the CON.
Conclusions: The results of the study suggest that ES as an adjunct to a supervised and individualised exercise program may contribute to aerobic fitness and peripheral muscle strength in patients with CF.

ePS1.05
The barriers to expectorating sputum in children with cystic fibrosis
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Objectives: Sputum is the gold standard microbiology sample for the diagnosis of lower airway infection in cystic fibrosis (CF). Alternatives are less reliable (cough swabs), time consuming (induced sputum) or invasive (bronchoscopy samples). Expectoration of sputum is also vital for effective airway clearance. Unfortunately, many children are unwilling or unable to expectorate sputum. We wanted to understand the barrier to sputum expectoration and identify interventions to overcome them.
Method: We created the 17-point Barriers Of Spitting Sputum (BOSS) questionnaire covering the educational, mechanical, psychological and resource related barriers to sputum expectoration. Children >6 years attending the CF clinic at the North West Midlands CF Centre (UK) were asked to complete the questionnaire. A physiotherapist analysed each questionnaire and created a personalised plan to address the barriers identified by each child.
Results: 43 children completed the questionnaire. 10 (23%) always expectorated sputum, 29 (68%) sometimes expectorated and sometimes swallowed and 4 (9%) never expectorated. Children in all three groups reported single or multiple barriers to expectoration. The most commonly identified barriers were: embarrassment/worry about being seen expectorating, physical difficulty in expectorating thick sputum, nausea/vomiting caused by expectoration and fear of sputum getting stuck. Emotional barriers were addressed by CF psychologist and the other issues by the CF physiotherapy team.
Conclusion: The BOSS questionnaire has enabled us to identify the barrier to sputum expectoration in children with CF which we have attempted to address. We now plan to repeat the questionnaire to see if this process has increased the percentage of children who are willing to expectorate sputum.

ePS1.06
Ventilatory limitations to exercise in cystic fibrosis are dependent on lung function and equation selection
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Objectives: During cardiopulmonary exercise testing (CPET), maximal minute ventilation (VEmax) is closely analysed to determine if a patient is able to achieve maximal effort when ventilatory limited (VL). VL is determined if the patient's VEmax exceeds 85% of their predicted maximal voluntary ventilation (MVV), with a number of equations used to predict MVV based on lung function. The aim of this study was to identify how patients of differing disease severity were deemed to have VL when performing a CPET, dependent on how MVV was calculated.
Method: Eighty-seven patients (56 adults/31 paediatrics, 51 male/36 female) were categorised into severe (<40% FEV_1%Pred, n = 5, 5 adults), moderate (40–69% FEV_1%Pred, n = 26, 22 adults) and mild (>70% FEV_1% Pred, n = 56, 29 adults) disease severity. All performed a CPET using a validated combined ramp and supra-maximal verification protocol. VL was determined from three different equations to predict MVV: $FEV_1 \times 35$; $FEV_1 \times 40$; and a paediatric-specific equation (27.7 (FEV_1) + 8.8 ($PredFEV_1$)) from Stein et al (2003).
Results: Five (100%) of the adult patients in the severe category were deemed VL using both the $FEV_1 \times 35$ (124.4 ± 12.2%) and $FEV_1 \times 40$ (108.8 ± 10.6%) equations. In the moderate category, 17 (81%) adult patients, were VL using the $FEV_1 \times 35$ (109.0 ± 27.5%) compared with, 14 (69%) when using the $FEV_1 \times 40$ (95.3 ± 24.0%) equation. In the mild category, 16 (52%) adults were VL using $FEV_1 \times 35$ (90.6 ± 19.9%) compared with 10 (36%) when using $FEV_1 \times 40$ (79.3 ± 14.4%). For children using the paediatric (Stein) equation, 3 (75%) of the paediatric patients were VL in the moderate category (87.2 ± 2.7%), compared with 11 (41%) (83.4 ± 18.5%) in the mild category.