G.20 Exercise

Review question: What is the effectiveness of programmes of exercise in the management of cystic fibrosis?

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Full citation Enright, S., Chatham, K., Ionescu, A. A., Unnithan, V. B., Shale, D. J., Inspiratory muscle training improves lung function and exercise capacity in adults with cystic fibrosis, Chest, 126, 405-11, 2004 Ref Id 332644 Country/ies where the study was carried out See Houston 2013 Study type See Houston 2013 Aim of the study See Houston 2013 Study dates See Houston 2013 Source of funding See Houston 2013	Sample size See Houston 2013 Characteristics See Houston 2013 Inclusion criteria See Houston 2013 Exclusion criteria See Houston 2013	Interventions See Houston 2013	Details See Houston 2013	Results See Houston 2013	Limitations See Houston 2013 Other information See Houston 2013
Full citation Gruber, W., Orenstein, D. M.,	Sample size	Interventions Intervention 1: Interval-	Details Study setting.	Results FEV1 (% predicted)	Limitations The quality of this study was

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Braumann, K. M., Beneke, R., Interval exercise training in cystic fibrosis - Effects on exercise capacity in severely affected adults, Journal of Cystic Fibrosis, 13, 86-91, 2014 Ref Id 425890 Country/ies where the study was carried out Germany Study type Cohort study Aim of the study To investigate the effects of interval exercise training on lung function power and oxygen uptake (VO2) at peak performance (peak) and ventilatory anaerobic threshold (VAT) in CF patients who were unable to participate in a standard exercise program and to compare these interval exercise training	N=43 (20 in interval training group, 23 in standard exercise programme group) Characteristics Rehabilitation clinic inpatients with CF Baseline characteristics at admission: Age, mean (SD): interval training group 26.4 (7.5) vs standard exercise programme group 26.3 (9.9) FEV1 (% predicted), mean (SD): interval training group 25.5 (7.5) vs standard exercise programme group 31.6 (4.2) Inclusion criteria FEV1 < 40% predicted stability of disease throughout the study period no acute exacerbation during the 4 weeks prior to the in-patient program Exercise capacity was determined by an incremental exercise test. The participants were allocated into training groups according to results of oxygen saturation (SpO2) during incremental exercise testing. Subjects who de-saturated (SpO2 b 90%) at very low power (≤0.3 W/kg) or had a SpO2 ≤ 90%	training for 6 weeks The IT treadmill program was performed at the individual's comfortable continuous walking speed, between 3 and 4 km/h lasting 16 min, 5 times weekly and consisted of ten intervals of 20 or 30 s high intensity bouts at 50% of maximal grade achieved during steep ramp test (SRT), followed by 60 s active recovery phases at 0% grade treadmill inclination. Supplemental oxygen was administered to reach a	Study design. At admission and at discharge, all participants underwent a complete medical examination which included measurement of lung function, exercise capacity, height and bodyweight. Prior to beginning IT, the IT group performed an additional Steep Ramp Test (SRT) to determine the exercise intensity of IT. Data collection. Forced Expiratory Volume in 1 s, (FEV1%pred), and Vital Capacity (VC% pred) were measured by spirometry (Master screen, Jaeger, Wuerzburg, Germany) according to recommended techniques, and values were expressed as a percentage of age, sex and anthropometry related to normal values. Body composition was measured using the bioelectrical impedance analysis system (BIA) (Data input, Darmstadt Germany). Cardio-pulmonary exercise testing (CPET) was performed on an electro-magnetically braked cycle ergometer (Examiner, Lode B.V. Groningen, The Netherlands). Gas exchange and ventilatory measures were recorded breath by breath (Master Screen CPX, Viasys Healthcare GmbH, Hoechberg, Germany). After a period of rest (3 min) and after a 3 min phase of unloaded cycling, power was	Mean (SD): interval training group at discharge: 24.4 (6.6) and interval training group at baseline: 25.5 (7.5) vs standard exercise programme at discharge: 34.4 (5.5) and standard exercise programme at baseline: 31.6 (4.2) FVC% predicted Not reported VO2 peak (ml/kg/min) Mean (SD): interval training group at discharge: 23.4 (6.9) and interval training group at baseline: 20.9 (4.2) vs standard exercise programme at discharge: 24.6 (6.8) and standard exercise programme at baseline: 21.3 (6.5) BMI Interval training group at discharge: 17.5 (2.1) and interval training group at baseline: 17.1 (2.1) vs	assessed using the Newcastle-Ottawa scale assessment tool: Selection: High risk of bias (The participants were allocated into training groups according to results of oxygen saturation during incremental exercise testing. Patients with CF who were unable to participate in a standard exercise programme were assigned to the interval training group) Comparability: High risk of bias (The study does not control for any factor) Outcome: Low risk of bias (Description of tests is provided; results for all 43 patients are provided) Other information

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responses with corresponding effects in CF patients performing the standard exercise program. Study dates Not reported Source of funding Not reported	at rest were allocated to IT. The other participants were assigned to SEP. Exclusion criteria untreated CF-related diabetes clinical evidence of exercise limiting cardiac, neurological or musculo-skeletal problems intravenous antibiotic therapy during the 4 weeks prior to the program ventilatory anaerobic threshold (VAT) not detectable.	haemoglobin oxygen saturation of more than 90% during exercise training. The SRT was repeated every 2 weeks to adjust 50% maximum short-time exercise capacity (MSEC) according to potential individual changes in MSEC. Intervention 2: Standard exercise program Participants exercised 5 times weekly for 6 weeks. All training sessions lasted 45 min and consisted of different sport activities depending on participants'	increased every minute by 10–20 W(Godfrey protocol) depending on the patient's height and physical fitness. Participants were encouraged to make a maximal effort, and the test was continued until the subject could no longer maintain a pedaling cadence of 60 rpm or SpO2 was below 85%. To specify the Ventilatory Anaerobic Threshold (VAT), the excess carbon dioxide method (ExCO2), and the modified V-Slope method were used. Heart rate (HR) was measured continuously using 12 lead ECG.	standard exercise programme at discharge: 18.7 (2.7) and standard exercise programme at baseline: 18.3 (2.0) Quality of life Not reported Time to next exacerbation Not reported Preference for training programme Not reported Adverse events Not reported	

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		fitness level (prolonged endurance exercise in terms of walking or Nordic-Walking complemented by ball games, stretching, balance training, and resistance training). All sessions were supervised by a specially trained and experienced sport-therapist. The training intensity during endurance training was set at a HR corresponding to 80–90% of VO2VAT equivalent to 60–75% VO2peak and monitored with a portable			

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		heart rate monitor.			
Full citation Hebestreit, H., Kieser, S., Junge, S., Ballmann, M., Hebestreit, A., Schindler, C., Schenk, T., Posselt, H. G., Kriemler, S., Long-term effects of a partially supervised conditioning programme in cystic fibrosis, European Respiratory Journal, 35, 578-83, 2010 Ref Id 361305 Country/ies where the study was carried out See Radtke 2015 Study type See Radtke 2015 Aim of the study See Radtke 2015 Study dates See Radtke 2015 Source of funding See Radtke 2015	Sample size See Radtke 2015 Characteristics See Radtke 2015 Inclusion criteria See Radtke 2015 Exclusion criteria See Radtke 2015	Interventions See Radtke 2015	Details See Radtke 2015	Results See Radtke 2015	Limitations See Radtke 2015 Other information See Radtke 2015

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Full citation Hommerding, P. X., Baptista, R. R., Makarewicz, G. T., Schindel, C. S., Donadio, M. V. F., Pinto, L. A., Marostica, P. J. C., Effects of an educational intervention of physical activity for children and adolescents with cystic fibrosis: A randomized controlled trial, Respiratory Care, 60, 81-87, 2015 Ref Id 425924 Country/ies where the study was carried out See Radtke 2015 Study type See Radtke 2015 Aim of the study See Radtke 2015 Study dates See Radtke 2015 Source of funding See Radtke 2015	Sample size See Radtke 2015 Characteristics See Radtke 2015 Inclusion criteria See Radtke 2015 Exclusion criteria See Radtke 2015	Interventions See Radtke 2015	Details See Radtke 2015	Results See Radtke 2015	Limitations See Radtke 2015 Other information See Radtke 2015
Full citation	Sample size	Interventions	Details	Results	Limitations

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Houston, B. W., Mills, N., Solis-Moya, A., Inspiratory muscle training for cystic fibrosis, Cochrane Database of Systematic Reviews, 11, CD006112, 2013 Ref Id 333651 Country/ies where the study was carried out Enright 2004: UK Study type Houston 2013 Cochrane systematic review Enright 2004 RCT Aim of the study Houston 2013 To determine the effects of inspiratory muscle training in the management of people with CF. Enright 2004 To investigate the effects of high-intensity inspiratory muscle training	Enright 2004 N=19 adults with CF IMT group: n=9 Control group: n=10 Characteristics Enright 2004 Age of total cohort (all adults): mean (SD) age = 22 (4.2) years. IMT at 80% of maximal effort group: mean (SD) age = 24.8 (5.5) years Control group: mean (SD) age = 21.3 (2.7) years Gender split of total cohort: 16 male, 14 female. IMT at 80% of maximal effort group: 4 males, 6 females Control group: 6 males, 4 females All had similar age, height, weight and lung function at baseline None of the participants were receiving oral steroids at the time of the study* *Information extracted from individual paper rather than from systematic review Inclusion criteria People with CF attending who were outpatients attending an adult CF centre* Stable condition, defined as: No change in symptoms or	Enright 2004 Intervention: IMT at 80% of “maximal inspiratory effort” direct supervision at home by designated training IMT is incremental maximal effort with progressively shorter rest periods 3 times a week for 8 weeks Control: no training	Enright 2004 Parallel design over 8 weeks. Study setting: single centre in the UK. Sample size calculation was undertaken and indicated that study needed at least 9 patients in each group.	Enright 2004 FEV1 % predicted Not reported FEV1 (litres) Mean (SD) at 2 to 6 months: IMT (80% of maximal effort) (n=9): 2 (1) vs control (n=10): 2 (1). Mean difference [95% CI]: 0.0 [-0.90, 0.90] FVC % predicted Not reported FVC (litres) Mean (SD) at 2 to 6 months: IMT (80% of maximal effort) (n=9): 3 (1.2) vs control (n=10): 2.9 (1). Mean difference [95% CI]: 0.10 [-0.90, 1.10] VO2 Not reported Time to next exacerbation Not reported Quality of life Not reported Preference for training programme Not reported Body composition	Houston 2013 AMSTAR checklist score: 10/11 (sources of funding or support was not indicated in relation to the included studies, only in relation to the systematic review) Enright 2004 Random sequence generation (selection bias): Unclear risk (No information provided) Allocation concealment (selection bias): Unclear risk (No information provided) Blinding (performance bias and detection bias) (all outcomes): High risk (Performance bias: the comparison was “no training”making it clear to the participants which arm they were in. Detection bias: outcome assessors

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(IMT) on inspiratory muscle function and other indicators including lung function.* * Extracted from individual paper rather than from systematic review Study dates Houston 2013 Searches were updated and run again on 01 August 2013. Enright 2004 Study dates not reported. * * Extracted from individual paper rather than from systematic review Source of funding Houston 2013 Internal sources: University of Teesside, Middlesbrough, UK. External sources: No sources of support supplied. Enright 2004 The study was supported by the Physiotherapy Research	treatment in a month preceding the study; FEV1 within 10% of the best value recorded in the previous 12 months* *Information extracted from individual paper rather than from systematic review Exclusion criteria People with cor pulmonale, liver cirrhosis, or diabetes mellitus were excluded from the study* *Information extracted from individual paper rather than from systematic review			Not reported Adverse events Not reported	at the final data collection session, although they did not state whether this was the case at the initial assessment or even if the same assessors carried out all the assessments). Incomplete outcome data (attrition bias) (all outcomes): Unclear risk (No mention is made of whether all participants completed the trial or not. Nor are there any statistical indications. Intention-to-treat: unclear.) Selective reporting (reporting bias): Unclear risk (Insufficient information available to arrive at a conclusion) Other bias: Unclear risk (Insufficient information available to arrive at a conclusion) Other information

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Foundation and the Cystic Fibrosis Trust* *Extracted from individual paper rather than from systematic review					
Full citation Klijn, P. H. C., Oudshoorn, A., Van Der Ent, C. K., Van Der Net, J., Kimpen, J. L., Helders, P. J. M., Effects of anaerobic training in children with cystic fibrosis: A randomized controlled study, Chest, 125, 1299-1305, 2004 Ref Id 425960 Country/ies where the study was carried out See Radtke 2015 Study type See Radtke 2015 Aim of the study See Radtke 2015 Study dates See Radtke 2015 Source of funding	Sample size See Radtke 2015 Characteristics See Radtke 2015 Inclusion criteria See Radtke 2015 Exclusion criteria See Radtke 2015	Interventions See Radtke 2015	Details See Radtke 2015	Results See Radtke 2015	Limitations See Radtke 2015 Other information See Radtke 2015

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
See Radtke 2015					
Full citation Kriemler, S., Kieser, S., Junge, S., Ballmann, M., Hebestreit, A., Schindler, C., Stussi, C., Hebestreit, H., Effect of supervised training on FEV1 in cystic fibrosis: a randomised controlled trial, Journal of Cystic Fibrosis, 12, 714-20, 2013 Ref Id 361395 Country/ies where the study was carried out See Radtke 2015 Study type See Radtke 2015 Aim of the study See Radtke 2015 Study dates See Radtke 2015 Source of funding See Radtke 2015	Sample size See Radtke 2015 Characteristics See Radtke 2015 Inclusion criteria See Radtke 2015 Exclusion criteria See Radtke 2015	Interventions See Radtke 2015	Details See Radtke 2015	Results See Radtke 2015	Limitations See Radtke 2015 Other information See Radtke 2015
Full citation	Sample size	Interventions	Details	Results	Limitations

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Moorcroft, A. J., Dodd, M. E., Morris, J., Webb, A. K., Individualised unsupervised exercise training in adults with cystic fibrosis: a 1 year randomised controlled trial, Thorax, 59, 1074-80, 2004 Ref Id 361493 Country/ies where the study was carried out See Radtke 2015 Study type See Radtke 2015 Aim of the study See Radtke 2015 Study dates See Radtke 2015 Source of funding See Radtke 2015	See Radtke 2015 Characteristics See Radtke 2015 Inclusion criteria See Radtke 2015 Exclusion criteria See Radtke 2015	See Radtke 2015	See Radtke 2015	See Radtke 2015	See Radtke 2015 Other information See Radtke 2015
Full citation Orenstein, D. M., Hovell, M. F., Mulvihill, M., Keating, K. K., Hofstetter, C. R., Kelsey, S., Morris, K., Nixon, P. A.,	Sample size N=67 (qualified and agreed to participate). Only subjects with data at both time points were included in the comparisons: For the analysis at 6 months follow up, N=56 (26 in the	Interventions Intervention 1. Aerobic training regimen Each child was given a	Details Study setting The Children's Hospital of Pittsburgh Randomisation and blinding. Participants were assigned at random to either the aerobic or upper-body strength training	Results FEV1 (% predicted) mean (SD): Aerobic at 6 months: 89.65 (19.32) and aerobic at baseline: 92.22 (18.33) vs strength at 6 months: 86.07	Limitations The quality of this study was assessed using the Cochrane risk of bias tool: Random sequence generation

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Strength vs aerobic training in children with cystic fibrosis: a randomized controlled trial, Chest, 126, 1204-14, 2004 Ref Id 333783 Country/ies where the study was carried out USA Study type Randomised Controlled Trial Aim of the study To compare the effects of a home-based, semi-supervised, upper-body strength-training regimen with a similarly structured aerobic training regimen. Study dates Data were collected during a 1-year randomized clinical trial. Source of funding The study was supported by National Heart, Lung, and	aerobic group and 30 in the strength group). For the analysis at 12 months follow up, N=53 (25 in the aerobic group and 28 in the strength group). Characteristics Age range: 8-18 Inclusion criteria People with confirmed CF diagnosis Exclusion criteria People were excluded if: they were already engaging in regular aerobic exercise or weight training for 20 min at least three times per week; their peak work capacity was 110% of predicted based on the Godfrey equation; their oxygen uptake (millimeters per minute) was 100% of predicted based on the Franklin or Rowland equation; their Vo2peak was 45 mL/kg/min; they gave a submaximal effort, which was defined as a respiratory exchange ratio of --- 1.0 or a subjective interpretation by the tester,	stair-stepping machine Participants were encouraged to exercise at least 3 times per week for 1 year Counselors conducted in-home visits once a week for the first 8 weeks followed by monthly visits for the remainder of the study Participants were instructed to exercise 5 min per session, gradually increasing their exercise to 30 min per session over the course of the study Children were taught to gradually increase their target heart	conditions following baseline strength, aerobic fitness, and pulmonary function measures. Random assignment was determined by the research coordinator from a predetermined list of random numbers. Staff members were notified of each child's assignment immediately following baseline measures, precluding advanced knowledge of assignment, and all measurement staff members remained blind to assignment through follow-up measures. Separate counseling staff remained blind to outcome measures throughout the trial. Investigators remained blind to outcome measures until all youth had completed their 12-month assessment measures. Data were transferred to coauthors in San Diego for analysis, thereby ensuring greater separation of clinical and analysis components of the trial. Data collection Measures were obtained at baseline, 6 months, and 12 months at least 2 weeks following high doses of tobramycin, ciprofloxacin, or IV treatments. Resting measures were obtained for 2 min prior to aerobic fitness testing. Progressive exercise testing was conducted on an electronically braked cycle ergometer following the Godfrey protocol. Patients began	(17.16) and strength at baseline: 90.3 (17.85) mean (SD): Aerobic at 12 months: 90.32 (17.92) and aerobic baseline: 91.51 (18.34) vs strength at 12 months: 90.29 (15.82) and strength at baseline: 91.18 (18.07) FVC% predicted Not reported VO2 peak Peak oxygen consumption (ml/min/kg), mean (SD): Aerobic at 6 months: 32.90 (6.06) and aerobic baseline: 34.81 (5.45) vs strength at 6 months: 30.38 (6.21) and strength at baseline: 32.54 (5.88) Peak oxygen consumption (ml/min/kg), mean (SD): Aerobic at 12 months: 33.69 (7.16) and aerobic baseline: 34.60 (5.46) vs strength at 12 months: 30.91 (6.73) and strength	(selection bias): Unclear risk (the authors mention a predetermined list of random numbers but do not report how the list was generated) Allocation concealment (selection bias): Unclear risk (not reported) Blinding of participants and personnel (performance bias) (all outcomes): High risk (blinding of participants was not possible; staff members were notified of each child's assignment immediately following baseline measures) Blinding of outcome assessment (detection bias) (all outcomes): Low risk (all measurement staff members remained blind to assignment through follow-up measures)

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Blood Institute grant HL52306, and in-kind support from the Center for Behavioral Epidemiology and Community Health, Graduate School of Public Health, San Diego State University.	on more than one baseline testing date.	rate to 70% of their maximum heart rate Intervention 2. Upper-body strength training regimen Each child was given an upper-body-only-weight-resistance machine Participants were encouraged to exercise at least 3 times per week for 1 year Counselors conducted in-home visits once a week for the first 8 weeks followed by monthly visits for the remainder of the study Participants were instructed to perform biceps curls,	pedaling at 0 W for 1 min, with the workload increasing by 10 W, 15 W, or 20 W each minute depending on the patients' height and clinical status. Maximal effort was encouraged. The peak work capacity was defined as the highest workload (watts) sustained for 1 min, and peak work capacity percentage of predicted was determined from the equations of Godfrey based on height and gender. Metabolic equipment (Medical Graphics; St. Paul, MN) provided online, breath-by-breath measures of oxygen uptake. Peak values were determined from the last 15 s of exercise. A 12-lead ECG was monitored continuously, and heart rate was determined each minute and at peak exercise. Pulmonary Function Testing: Prior to exercise testing, participants performed pulmonary function tests according to the American Thoracic Society standards. Lung volumes were determined by body plethysmography. Spirometry, including flow volume curves both before and after inhalation of a bronchodilator (albuterol), was performed using a body plethysmograph (Sensor Medics System 6200; SensorMedics; Yorba Linda, CA), with the patient seated comfortably. FVC and FEV1 were chosen from among no fewer than	at baseline: 32.64 (6.22) Body composition Not reported Quality of life Not reported Time to next exacerbation Not reported Preference for training programme Not reported Adverse events Not reported	Incomplete outcome data (attrition bias) (all outcomes): Low risk (intention-to-treat analysis was employed. Only subjects with data at both time points were included: 56/67 and 53/67 for the 6-month and 12-month follow-up respectively) Selective reporting (reporting bias): Low risk (The authors mention that measures were obtained at baseline, at 6 months and at 12 months and report outcomes at all these follow-ups) Other bias: Low risk (not detected) Other information

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		lateral pull-downs, and military and bench presses Exercises were individually tailored to the participants' strength, and the exercise increased gradually by the number of sets and repetitions as well as by the amount of resistance per bout Children were instructed to keep their heart rate <55% of their maximum, based on the baseline exercise test. Attachments for and leg exercise were not recommended in order to decrease the likelihood of	three nor more than eight maneuvers. The "best test" was chosen on the basis of the largest sum of FVC and FEV1. Data analysis Intent-to-treat analysis, was employed. Descriptive analyses and t tests were performed. T tests were performed using the pair-wise option for missing data; therefore, only subjects with data at both points were included in the individual comparisons. The pair-wise method created different sample sizes and different means for the variables used in each comparison. The distributions were examined and adjusted using natural log transformations or squaring to improve normality.		

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		lower-body exercise and increase difference in training between groups			
Full citation Radtke, T., Nolan, S. J., Hebestreit, H., Kriemler, S., Physical exercise training for cystic fibrosis.[Update of Cochrane Database Syst Rev. 2008;(1):CD002768 ; PMID: 18254007], Cochrane Database of Systematic Reviews, 6, CD002768, 2015 Ref Id 426109 Country/ies where the study was carried out Hebestreit 2010: Germany Hommerding 2015: Brazil Klijn 2004: Netherlands Kriemler 2013: Switzerland Moorcroft 2004: UK	Sample size Radtke 2015 13 studies which included 402 participants, met the inclusion criteria. The numbers in each study ranged from 9 to 72 participants. Hebestreit 2010 N=38 Exercise group n=23 Control group n=15 Hommerding 2015 N=34 Exercise group n=17 Control group n=17 Klijn 2004 N=20 Intervention group n=11 Control group n=9 3 participants dropped out; 1 withdrew from the training group for practical reasons Kriemler 2013 N=39 Aerobic training group (n=17)	Interventions Radtke 2015 Any type of prescribed physical exercise training delivered to people with CF compared to usual care. Hebestreit 2010 Intervention: endurance-type and strengthening exercises Unsupervised programme Participants agreed to increase their vigorous physical activities by a minimum of 3x 60 min per	Details Radtke 2015 Relevant studies were identified from the Cystic Fibrosis and Genetic Disorders Group's Cystic Fibrosis Trials Register using the term: exercise. The reference listso for each RCT and of review articles were searched for additional publications that may contain RCTs. Authors of studies included in this review and other experts in the field were contacted and asked for information on other published and unpublished studies. Two authors independently assessed the titles and abstracts of identified citations and selected the studies to be included in the review. Each author independently extracted data using standard data acquisition forms. Two authors independently assessed the risk of bias for each included study according to the Cochrane risk of bias tool. Hebestreit 2010	Results Hebestreit 2010 FEV1 % predicted Mean (SD) change at 3-6 months: combined aerobic and anaerobic training (n=22): -2.1 (8.4) vs no training (n=13): -4.1 (11.8). Mean difference [95% CI]: 2.00 [-5.31, 9.31] Mean (SD) change at 6 months off training for combined aerobic and anaerobic training (n=18): -6 (12.5) vs no training (n=12): -4.9 (8.7). Mean difference [95% CI]: -1.10 [-8.69, 6.49] Mean (SD) change at 12-18 months off training for combined aerobic	Limitations Radtke 2015 AMSTAR score: 10/11 (source of funding or support was given for the systematic review but not for the included studies) Hebestreit 2010 Random sequence generation (selection bias): High risk (40 folded paper tickets were put into a bag with a 3:2 ratio i.e. 24 tickets for the intervention group and 16 for the control group. Participants drew a ticket at random and the drawn ticket was then destroyed. Principal investigator was aware of the

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Rovedder 2014: Brazil Santana-Sosa 2012: Spain Santana-Sosa 2014: Spain Schneiderman-Walker 2000: Canada Selvadurai 2002: Australia Study type Radtke 2015 Cochrane systematic review Hebestreit 2010 RCT Hommerding 2015 RCT Klijn 2004 RCT Kriemler 2013 RCT Moorcroft 2004 RCT Rovedder 2014 RCT Santana-Sosa 2012 RCT	Strength training group (n=12) Control group (n=10) A separate control group from a parallel study (Hebestreit 2010) was added due to an unusual deterioration of physical health in the control group in this study (n=15) Moorcroft 2004 N=51 Exercise group (n=30) Control group (n=18) 42 completed the study Rovedder 2014 N=41 Exercise group n=19 Control group n=22 Santana-Sosa 2012 N=22 Exercise group n=11 Control group n=11 Santana-Sosa 2014 N=20 Exercise group n=10 Control group n=10 Schneiderman-Walker 2000 N=65 Exercise group (n=30) Control group (n=35) 7 dropouts Selvadurai 2002 N=66	week in the first 6 months of the study. An individual exercise plan was devised for participants; activity counselling was stopped after the first 6 months and participants were encouraged to maintain or further increase their physical activity level Control: Participants told to keep their activity level constant during the first 12 months of the study. During the second year (period from 12 - 24 months) they were free to change their	Multi-centre parallel RCT; duration 24months (6-month intervention and longterm, open follow-up period) Hommerding 2015 Single-centre parallel RCT; 3-month duration Klijn 2004 Single-centre, parallel RCT, 3-month duration. Kriemler 2013 Multi-centre, parallel RCT with 3 arms; 24 month (6-month intervention and long-term, open follow-up period) Moorcroft 2004 Single-centre, parallel RCT; 1-year duration. Rovedder 2014 Single-centre, parallel RCT; 3-months home-based exercise programme Santana-Sosa 2012 Single-centre, parallel RCT; 3-month duration (8 weeks training, 4 weeks detraining) Santana-Sosa 2014	and anaerobic training (n=20): -5.5 (10.1) vs no training (n=13): -9.1 (12.2). Mean difference [95% CI]: 3.60 [-4.37, 11.57] FVC % predicted Mean Difference (SE) in change at 3-6 months for combined aerobic and anaerobic training vs no training: 0.5 (2.45). Mean difference [95% CI]: 0.50 [-4.30, 5.30] Mean Difference (SE) in change at 6 months off training for combined aerobic and anaerobic training vs no training: 2.71 (3.61). Mean difference [95% CI]: 2.71 [-4.37, 9.79] Mean Difference (SE) in change at 12-18 months off training for combined aerobic and anaerobic training vs no training: 6.06 (2.87). Mean difference	number of lots in the bag) Allocation concealment (selection bias): High risk (Participants drew a folded paper ticket from an opaque bag with closed eyes. In case that all lots have been drawn out by 1 study group, allocation concealment would no longer exist) Blinding of participants and personnel (performance bias) (all outcomes): Unclear risk (Not possible to blind participants to intervention. Unclear whether personnel was blinded) Blinding of outcome assessment (detection bias) (all outcomes): Unclear risk (Outcome assessors were not blinded with respect to the participants'

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Santana-Sosa 2014 RCT Schneiderman-Walker 2000 RCT Selvadurai 2002 RCT Aim of the study Radtke 2015 To determine the effects of physical exercise training compared to no training on aerobic exercise capacity, forced expiratory volume in one second, health-related quality of life and other patient-relevant (secondary) outcomes in cystic fibrosis. Hebestreit 2010 To determine the effects of a 6-month home-based and individualised conditioning programme on multiple outcomes	Aerobic training group (n=22) Resistance training group (n=22) Control group (n=22) No dropouts Characteristics Radtke 2015 People with CF, of any age, and any degree of disease severity, diagnosed on the basis of clinical criteria and sweat testing or genotype analysis. Hebestreit 2010 People with CF >12 years Exercise group (n = 23): mean (SD) age 19.5 (6.4) years. Control group (n = 15): mean (SD) age 19.4 (5.3) years. Hommerding 2015 Children and young people with CF Sex: 20 boys, 14 girls Exercise group (n = 17): mean (SD) age 13.4 (2.8) years. Control group (n = 17): mean (SD) age 12.7 (3.3) years. Klijn 2004 Children and young people with CF with stable disease.	activity behaviour Hommerding 2015 Intervention: aerobic exercise programme Unsupervised programme Included jogging, swimming, walking, ball games and stretching exercises. based on verbal and written guidelines twice a week for at least 20 min for 3 months participants received telephone calls every 2 weeks and instructions were provided by one of the authors	Single-centre, parallelRCT; 3-month study (8weeks training, 4weeks detraining) Schneiderman-Walker 2000 Single-centre, parallel RCT, 3-year duration. Selvadurai 2002 Single-centre, parallel RCT; hospital admission for recurrent chest infections	[95% CI]: 6.06 [0.43, 11.69] VO2 peak during maximal exercise (ml/min per kg BW) Mean Difference (SE) in change at 3-6 months for combined aerobic and anaerobic training vs no training: 2.04 (1). Mean difference [95% CI]: 2.04 [0.08, 4.00] Mean Difference (SE) in change at 6 months off training for combined aerobic and anaerobic training vs no training: 0.7 (1.18). Mean difference [95% CI]: 0.70 [-1.61, 3.01] Mean Difference (SE) in change at 12-18 months off training for combined aerobic and anaerobic training vs no training: 3.73 (1.23). Mean difference [95% CI]: 3.73 [1.32, 6.14]	group allocation for VO2 peak) Incomplete outcome data (attrition bias) (all outcomes): Unclear risk (5 participants dropped out during the first 12 months of the study: 3 gave no reason, 1 joined another study and 1 moved away At 18 and 24 months, dropout rate was 13% and 26% respectively. Dropouts were balanced between groups. Reasons for drop out were not recorded Intention-to-treat was not performed) Selective reporting (reporting bias): Unclear risk (Anaerobic capacity (PP, MP) was only reported for 18 - 24 months follow up (non significant)and results for HRQoL are only presented for the scale 'physical functioning'. No

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
at 12 and 18 months after the programme had ended.* Hommerding 2015 To evaluate the effect of an aerobic exercise programme based on verbal and written guidelines on multiple outcomes in children and young people with cystic fibrosis.* Klijn 2004 To investigate the effects of anaerobic training in children with CF.* Kriemler 2013 To determine the effects of a 6-month partially supervised aerobic training or a supervised strength training programme in comparison to no intervention on FEV1 and other secondary outcomes in people with cystic fibrosis,	Exercise group (n = 11): mean (SD) age 13.6 (1.3) years. Control group (n = 9): mean (SD) age 14.2 (2.1) years. Kriemler 2013 Participants with CF aged >12 years Aerobic training group (n = 17): mean (95% CI) age 23.8 (21.5 to 26.5) years Strength training group (n = 12): mean (95% CI) age 19.0 (16.0 to 22.0) years Control group (n = 10): mean (95% CI) age 20.3 (17.0 to 23.6) years Moorcroft 2004 Adults with CF Exercise group (n = 30): mean (SD) age 23.5 (6.4) years. Control group (n = 18): 23.6 (5.5) years. Rovedder 2014 People with CF ≥ 16 years Exercise group (n = 22): mean (SD) age 23.8 (8.3) years. Control group (n = 19): mean (SD) age 25.4 (6.9) years.	Control: usual care participants were instructed about aerobic exercises once at baseline according to the CF centre routine Klijn 2004 Intervention: anaerobic training Supervised programme 2 days per week for 30 to 45 min 12 weeks Control: normal daily activities 12 weeks Kriemler 2013 Intervention 1: aerobic training Unsupervised programme 24-months: 6-month		Time to next exacerbation Not reported Quality of life, subjective health perception (CFQ-R) Mean Difference (SE) in change at 3-6 months for combined aerobic and anaerobic training vs no training: 9.91 (4.6). Mean difference [95% CI]: 9.91 [0.89, 18.93] Mean Difference (SE) in change at 6 months off training for combined aerobic and anaerobic training vs no training: -2.31 (6.71). Mean difference [95% CI]: -2.31 [-15.46, 10.84] Mean Difference (SE) in change at 12-18 months off training for combined aerobic and anaerobic training vs no training: 9.89 (4.72). Mean difference	effects were observed for all other HRQoL scales) Other bias: Unclear risk (Financial support (max 200 Euro) was offered for intervention group participants to foster the realisation of the exercise training plan) Hommerding 2015 Random sequence generation (selection bias): Low risk (Participants were allocated to the intervention or control group in blocks of 6. A computer-based program was used for randomisation) Allocation concealment (selection bias): Unclear risk (Not discussed) Blinding of participants and personnel (performance bias) (all outcomes): Not

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
and to test the long-term effects 6 and 18 months after the end of the intervention.* Moorcroft 2004 To examine the effectiveness of an individualised unsupervised home based exercise programme in adults with cystic fibrosis over a 1 year period.* Rovedder 2014 To assess the effects of a home exercise programme, based on aerobic training and muscle strength training, in people with cystic fibrosis, for a period of 3 months.* Santana-Sosa 2012 To assess the effects of an 8-week intrahospital combined circuit weight and aerobic training program performed by	Santana-Sosa 2012 Children and young people with CF Training group (n = 11): mean (SEM, range) age 11 years (3 years, 5 - 15 years) Control group (n = 11): mean (SEM, range) age 10.0 years (2 years, 6 - 14 years) Santana-Sosa 2014 Children and young people with CF Training group (n = 10): mean (SEM) age 11.1 (1.1) years. Control group (n = 10): mean (SEM) age 10.1 (1.1) years. Schneiderman-Walker 2000 People with CF 2 groups similar at baseline. Exercise group (n = 30): mean (SD) age 13.4 (3.9 years). Control group (n = 35): mean (SD) age 13.3 (3.6) years. Selvadurai 2002 Children and young people with CF aged 8 to 16 years admitted to hospital due to a pulmonary exacerbation Sex: 28 males, 38 females Aerobic training group (n = 22): mean (SD) age 13.2	intervention and long-term follow-up period 3 sessions per week of 30 to 45 minutes for 6 months and received support which was stopped thereafter Intervention 2: strength training Unsupervised programme 24-months: 6-month intervention and long-term follow-up period 3 sessions per week of 30 to 45 minutes for the first 6 months and received support which was stopped thereafter Control: no programme Participants in the control		[95% CI]: 9.89 [0.64, 19.14] Preference for training programme Not reported Body composition Mean (SD) change in body weight (kg) at 3-6 months: combined aerobic and anaerobic training (n=22): 1.1 (1.8) vs no training (n=15): 0 (2.6). Mean difference [95% CI]: 1.10 [-0.42, 2.62] Mean (SD) change in body weight (kg) at 6 months off training for combined aerobic and anaerobic training (n=19): 1.5 (4) vs no training (n=12): 1.3 (3.6). Mean difference [95% CI]: 0.20 [-2.52, 2.92] Mean (SD) change in body weight (kg) at 12-18 months off training for combined aerobic and anaerobic training (n=20): 1.8 (6) vs no	possible to blind participants to intervention. Unclear whether personnel was blinded. Blinding of outcome assessment (detection bias) (all outcomes): Unclear risk (Unclear whether outcome assessors were blinded) Incomplete outcome data (attrition bias) (all outcomes): Low risk (No drop outs were reported during the study) Selective reporting (reporting bias): Unclear risk (Blood pressure was measured prior to and after cardiopulmonary exercise testing but not reported. HR at rest and SaO2 at peak exercise were measured but results were not reported at baseline)

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
children with cystic fibrosis of low-moderate severity and stable clinical conditions on multiple outcomes.* Santana-Sosa 2014 To assess the effects of an 8-week combined 'whole muscle' (resistance+aerobic) and inspiratory muscle training on multiple outcomes in paediatric outpatients with cystic fibrosis.* Schneiderman-Walker 2000 To evaluate the effects of a 3-year home exercise program on pulmonary function and exercise tolerance in mildly to moderately impaired patients with cystic fibrosis and to assess whether regular aerobic exercise is a realistic treatment option.*	(2.0) years), 9males and 13 females Resistance training group (n = 22): mean (SD) age 13.1 (2.1) years, 10 males and 12 females Control group (n = 22): mean (SD) age 13.2 (2.0) years, 9 male and 1 females Inclusion criteria Radtke 2015 All randomised and quasi-randomised controlled clinical trials comparing exercise training of any type and duration with conventional care in people with cystic fibrosis were included. Hebestreit 2010 Participants with CF; age > 12 years; FEV1 > 35 % predicted; ability to perform physical activities. Hommerding 2015 Participants with CF aged 7 - 20 years; stable disease, no signs of exacerbation of respiratory symptoms in last 15 days. Klijn 2004 Participants with CF aged 9 - 18 years; a stable clinical condition (i.e., no need for	group were told to keep their activity level constant Free access to a fitness centre for 1 year after the first study year Moorcroft 2004 Intervention: aerobic exercise Unsupervised programme Exercise based on individual preferences general aerobic exercises for lower body and weight training for upper body) 3 times per week Control: usual activities Continue with usual activities		training (n=13): 1.8 (5). Mean difference [95% CI]: 0.0 [-3.78, 3.78] Mean Difference (SE) in change in BMI (kg/m2) at 3-6 months for combined aerobic and anaerobic training vs no training: 0.4 (0.29). Mean difference [95% CI]: 0.40 [-0.17, 0.97] Mean Difference (SE) in change in BMI (kg/m2) at 6 months off training for combined aerobic and anaerobic training vs no training: 0 (0.4). Mean difference [95% CI]: 0.0 [-0.78, 0.78] Mean Difference (SE) in change in BMI (kg/m2) at 12-18 months off training for combined aerobic and anaerobic training vs no training: -0.1 (0.52). Mean difference	Other bias: Unclear risk (No validity criteria for maximal performance during cardiopulmonary exercise testing were reported in the methods. The mean (SD) peak heart rate reached during the exercise test was 157.1 (38.5) beats per min in the training group and 167.7 (20. 8) beats per min in the control group, indicative of a submaximal effort. This likely underestimates the true VO2 peak of the study participants) Klijn 2004 Random sequence generation (selection bias): Unclear risk (Described as randomised, but no details of the method) Allocation concealment (selection bias): Low risk (Allocation

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Selvadurai 2002 To compare aerobic and resistance training in children with cystic fibrosis admitted to hospital with an intercurrent pulmonary infection with a control group.* *Extracted from individual paper Study dates Radtke 2015 Date of the most recent search: 10 March 2015. Hebestreit 2010 Not reported* Hommerding 2015 Data were collected from October 2010 to October 2011.* Klijn 2004 Not reported* Kriemler 2013	oral or IV antibiotic treatment in the 3 months prior to testing); the absence of musculoskeletal disorders; and an FEV1 > 30 % predicted. Kriemler 2013 Diagnosis of CF; aged 12 years and over; a FEV1 % predicted 35%; ability to perform physical activity without harm Moorcroft 2004 Participants with CF who were willing to participate were recruited from a population of 150 attending the adult CF centre inManchester at the time of the study. All participants had documented CF on the basis of clinical history plus either an increased sweat chloride or abnormal genetic testing Rovedder 2014 Participants diagnosed with CF in accordance with the criteria of the consensus;aged 16 years; 30 days of clinical respiratory disease stability Santana-Sosa 2012	Rovedder 2014 Intervention: aerobic and muscle strengthening exercises unsupervised programme 3-month home-based exercise programme printed guidance advised to perform the programme on a daily basis weekly telephone contacts were Control: no programme standard follow-up from a physiotherapist without any specific exercise instructions Santana-Sosa 2012		[95% CI]: -0.10 [-1.12, 0.92] Adverse events Not reported Hommerding 2015 FEV1 % predicted Mean (SD) change at 3 months: aerobic training (n=17): -1.8 (8.6) vs no training (n=17): 1 (14.2). FVC % predicted Mean (SD) change at 3 months: aerobic training (n=17): 0.4 (6.7) vs no training (n=17): 2 (12.2) VO2 peak during maximal exercise (ml/min per kg BW) Mean (SD) change at 3 months: Aerobic training (n=17): 1.1 (4.6) vs no training (n=17): 2.3 (11.9). Mean difference [95% CI]: -1.20 [-7.26, 4.86] Time to next exacerbation Not reported Quality of life Not reported Preference for training programme	concealed in opaque envelopes) Blinding of participants and personnel (performance bias) (all outcomes): Unclear risk (Not possible to blind participants to intervention. The primary researcher was blinded but their role in the study is unclear) Blinding of outcome assessment (detection bias) (all outcomes): Unclear risk (The primary researcher was blinded, but it is unclear whether this researcher was responsible for outcome assessment) Incomplete outcome data (attrition bias) (all outcomes): Low risk (Clear description and details about dropouts. 3 participants dropped out: 1

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Study entry for participants was at some point in time between December 2000 and March 2001; then people were seen after 3,6,12 and 24 months.* Moorcroft 2004 Not reported* Rovedder 2014 People were invited for inclusion between April 2008 and March 2011* Santana-Sosa 2012 The study was performed between January 2010 and January 2011* Santana-Sosa 2014 The study was performed between September 2011 and July 2012* Schneiderman-Walker 2000 Not reported* Selvadurai 2002	Potential participants included 111 children previously diagnosed using a genetic test for CF and treated at the Children's Hospital Nino Jesus in Madrid. Males or females aged 5 to 15 years and living in the Madrid area (able to attend training sessions) Santana-Sosa 2014 Potential participants included 95 outpatient children previously diagnosed with CF by genetic testing and treated at the Children's Hospital Nino Jesus in Madrid. Males or females aged 6 - 17 years and living in the Madrid area (able to attend training sessions) Schneiderman-Walker 2000 Participants with CF aged 7 - 19 years with an FEV1 > 40%predicted. Selvadurai 2002 Children with CF, between ages 8-16 years, who were admitted to the Royal Alexandra Hospital for Children for the treatment of an infectious pulmonary exacerbation.	Intervention: endurance and strengthening exercises supervised programme 8-week intrahospital programme followed by a 4-week detraining period 3 times per week same chest physiotherapy Control: no programme Participants were instructed on the positive effects of regular physical activity Santana-Sosa 2014 Intervention: aerobic + anaerobic + IMT		Not reported Body composition Mean (SD) change in BMI z-score at 3 months: Aerobic training (n=17): 0.2 (0.5) vs no training (n=17): 0.1 (0.2). Mean difference [95% CI]: 0.10 [-0.16, 0.36] Adverse events Not reported Klijn 2004 FEV1 % predicted No reported FVC % predicted Not reported VO2 peak during maximal exercise (ml/min per kg BW) Mean (SD) change at 3 months: anaerobic training (n=11): 1.5 (2.6) vs no training (n=9): -2.45 (10.3). Mean difference [95% CI]: 3.95 [-2.95, 10.85] Time to next exacerbation Not reported Quality of life	participant fromthetraining group withdrew for practical reasons; 2 from the control group did not complete assessments due to pulmonary exacerbations Intention-to-treat analysis was not performed) Selective reporting (reporting bias): Unclear risk (Results for HRQoL are only presented for the scale 'physical functioning' which was significantly higher in the training group after the 12-week training period. No change in this HRQoL scale was observed in the control group after 12-weeks. No significant effects were observed for any other HRQoL scales. Data were not reported in detail)

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Not reported* *Extracted from individual paper Source of funding Radtke 2015 The systematic review was supported by the National Institute for Health Research, via Cochrane infrastructure funding to the Cochrane Cystic Fibrosis and Genetic Disorders Group. Hebestreit 2010 The study was supported by a grant from the German cystic fibrosis foundation (Mukoviszidose e.V.)* Hommerding 2015 Not reported* Klijn 2004 Not reported* Kriemler 2013	Exclusion criteria Radtke 2015 Studies which involved pure respiratory muscle training were excluded. Hebestreit 2010 Non CF-related chronic diseases and CF-related conditions posing an increased risk to the participant when exercising. These were specifically oesophageal varicosis, pulmonary bullae, a < 80% drop in arterial oxygen saturation with exercise and signs of pulmonary hypertension on electrocardiogram and/or echocardiogram Hommerding 2015 Cognitive impairment, non CF-related bone and muscle abnormalities, heart disease with haemodynamic instability Klijn 2004 Not reported Kriemler 2013 Non-CF related chronic diseases and conditions posing an increased risk to the participant when exercising	supervised programme 8-week programme followed by a 4-week detraining period whole body aerobic and weight training 3 times per week plus 2 daily IMT sessions same chest physiotherapy Control: low intensity IMT Schneiderman-Walker 2000 Intervention 1: aerobic programme unsupervised programme home programme Minimum of 20 min 3 times per week for 3-years		Mean (SD) change in HRQoL physical function (CF questionnaire) at 3 months: anaerobic training (n=11): 88.4 (9) vs no training (n=9): 87.1 (17.9). Mean difference [95% CI]: 1.30 [-11.55, 14.15] Preference for training programme Not reported Body composition Not reported Adverse events Not reported Kriemler 2013 FEV1 % predicted Mean (SD) change at 3 months: aerobic training (n=14): 4.89 (8) vs no training (n=10): -7.92 (6.7). Mean difference [95% CI]: 12.81 [6.91, 18.71] Mean (SD) change at 3 months: anaerobic training (n=11): 3.19 (7.2) vs no training (n=10): -7.92 (6.7). Mean difference	Other bias: Unclear risk (Clearly stated inclusion criteria but exclusion criteria were not reported. Described statistical methods used in analysis) Kriemler 2013 Random sequence generation (selection bias): High risk (Participants were randomly assigned by a lot that was drawn from an opaque bag with closed eyes. Investigator was aware of the number of lots in the bag) Allocation concealment (selection bias): High risk (Participants drew a lot from an opaque bag with closed eyes. In case that all lots have been drawn out by one study group, allocation concealment would no longer exist)

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
The study was supported by a grant from the Swiss CF Foundation and the German Mukoviszidose e.V. * Moorcroft 2004 Not reported* Rovedder 2014 The study received financial support from the Porto Alegre Clinical Hospital Research Incentive Fund (FIPE-HCPA).* Santana-Sosa 2012 The study was funded by Fondo de Investigaciones Sanitarias (FIS, ref. no. PS09/00194) and Federación Española de Fibrosis Quística (II Convocatoria Pablo Motos). The work of I.F.G. was funded by the Van Coeverden Adriani Stichting and the	Moorcroft 2004 Participation in another clinical trial; pregnancy; transplant listing, or clinical cor pulmonale Rovedder 2014 Participants who refused to take part in the study; pregnant ladies; individuals with heart disease, orthopaedic or traumatological problems Santana-Sosa 2012 Severe lung deterioration, as defined by an FEV1 <50% predicted; unstable clinical condition (i.e. hospitalisation within the previous 3months); Burkholderia cepacia infection; musculoskeletal disease or any other disorder impairing exercise Santana-Sosa 2014 Severe lung deterioration (FEV1 < 50% predicted); unstable clinical condition (i.e., hospitalisation within the previous 3 months); Burkholderia cepacia infection or any disorder (e.g., musculoskeletal) impairing exercise	Control: maintained regular activity Selvadurai 2002 Intervention 1: aerobic training supervised programme 30 min, 5 times per week Training during hospital admission; mean (SD) duration of admission: 18.6 (3.9) days Intervention 2: resistance training supervised programme 30 min, 5 times per week Training during hospital admission; mean (SD) duration of admission:		[95% CI]: 11.11 [5.16, 17.06] Mean (SD) change at 6 months: aerobic training (n=15): 6.17 (11.6) vs no training (n=10): -11 (10.1). Mean difference [95% CI]: 17.17 [8.59, 25.75] Mean (SD) change at 6 months: anaerobic training (n=11): 8.51 (10.8) vs no training (n=10): -11 (10.1). Mean difference [95% CI]: 19.51 [10.57, 28.45] Mean (SD) change at 6 months off training: aerobic training (n=15): 1.09 (13.1) vs no training (n=8): -15.83 (12.4). Mean difference [95% CI]: 16.92 [6.07, 27.77] Mean (SD) change at 6 months off training: anaerobic training (n=11): 0.26 (12) vs no training (n=8): -15.83 (12.4). Mean difference	Blinding of participants and personnel (performance bias) (all outcomes): Unclear risk (Not possible to blind participants to intervention. Unclear whether personnel was blinded) Blinding of outcome assessment (detection bias) (all outcomes): Low risk (Outcome assessors were blinded for pulmonary function testing (primary outcome FEV1). Outcome assessors were not involved in supervision and delivery of the intervention) Incomplete outcome data (attrition bias) (all outcomes): Low risk (Clear description and details about excluded participants and drop-outs 3

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Nederlandse Cystic Fibrosis Stichting.* Santana-Sosa 2014 The study was funded by Fondo de Investigaciones Sanitarias (FIS, ref. no. PS09/00194) and Fundación Española de Fibrosis Quística (Spain).* Schneiderman-Walker 2000 Supported by a grant from the Canadian Cystic Fibrosis Foundation* Selvadurai 2002 Not reported* *Extracted from individual paper	Schneiderman-Walker 2000 Not reported Selvadurai 2002 Children with known pulmonary hypertension, or who required daytime oxygen prior to the pulmonary exacerbation which led to the hospital admission	18.8 (4.1) days Control: no specific training		[95% CI]: 16.09 [4.95, 27.23] Mean (SD) change at 18 months off training: aerobic training (n=12): 0.31 (13.2) vs no training (n=8): -12.14 (12). Mean difference [95% CI]: 12.45 [1.27, 23.63] Mean (SD) change at 18 months off training: anaerobic training (n=11): 4.87 (11.5) vs no training (n=8): -12.14 (12). Mean difference [95% CI]: 17.01 [6.27, 27.75] FVC % predicted Mean (SD) change at 3 months: aerobic training (n=14): 3.67 (7.3) vs no training (n=10): -5.57 (6.2). Mean difference [95% CI]: 9.24 [3.82, 14.66] Mean (SD) change at 3 months: anaerobic training (n=11): 1.8 (6.6) vs no training (n=10): -5.57 (6.2). Mean	participants were excluded at baseline due to FEV1 below 35% predicted. 8 participants dropped out at different time points (exacerbation n=1;non-compliance n=2; death n = 2; unclear reasons n= 3). 2 of the participants that dropped out for unclear reasons were in the control group and one was in the aerobic training group Dropout rate was 21%. Intention-to-treat analysis was not performed) Selective reporting (reporting bias): Low risk (All outcome detailed in methods were reported in results except HRQoL (secondary outcome) which was mentioned to be reported separately. In the meantime

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				difference [95% CI]: 7.37 [1.89, 12.85] Mean (SD) change at 6 months: aerobic training (n=15): 4.66 (8.9) vs no training (n=10): -7.85 (7.8). Mean difference [95% CI]: 12.51 [5.90, 19.12] Mean (SD) change at 6 months: anaerobic training (n=11): 6.2 (8.3) vs no training (n=10): -7.85 (7.8). Mean difference [95% CI]: 14.05 [7.16, 20.94] Mean (SD) change at 6 months off training: aerobic training (n=15): -0.67 (10.9) vs no training (n=8): -15.76 (10.4). Mean difference [95% CI]: 15.09 [6.01, 24.17] Mean (SD) change at 6 months off training: anaerobic training (n=11): -2.1 (9.9) vs no training (n=8): -15.76 (10.4).	published as Hebestreit et al. BMC Pulm Med. 2014, 27;14:26. HRQoL data were pooled from two intervention studies (Hebestreit 2010; Kriemler2013) and results were presented for baseline and 6-month follow up) Other bias: Unclear risk (Clearly stated inclusion and exclusion criteria and described statistical methods used in analysis. Due to the deterioration of physical health in the control group, the results of this study should be interpreted with caution Moorcroft 2004 Random sequence generation (selection bias): Unclear risk (Randomised to either active or control groups in a ratio of 3:2. A

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				Mean difference [95% CI]: 13.66 [4.38, 22.94] Mean (SD) change at 18 months off training: aerobic training (n=12): -3.29 (12.1) vs no training (n=8): -12.39 (10.6). Mean difference [95% CI]: 9.10 [-0.94, 19.14] Mean (SD) change at 18 months off training: anaerobic training (n=11): 1.24 (10.2) vs no training (n=8): -12.39 (10.6). Mean difference [95% CI]: 13.63 [4.13, 23.13] VO2 peak during maximal exercise (ml/min per kg BW) Mean (SD) change at 3 months: aerobic training (n=15): 7.26 (12.1) vs no training (n=10): -2.45 (10.3). Mean difference [95% CI]: 9.71 [0.86, 18.56] Mean (SD) change at 3 months: anaerobic training	stratified randomisation in blocks (block size not stated) was used to balance the groups for FEV1, sputum colonisation by Burkholderia cepacia and gender. No details of method reported) Allocation concealment (selection bias): Unclear risk (Not discussed) Blinding of participants and personnel (performance bias) (all outcomes): Unclear risk (Not possible to blind participants to intervention. Unclear whether personnel was blinded) Blinding of outcome assessment (detection bias) (all outcomes): Unclear risk (Unclear whether outcome assessors were blinded)

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				(n=11): 7.5 (12.8) vs no training (n=10):-1.84 (12.1). Mean difference [95% CI]: 9.34 [-1.31, 19.99] Mean (SD) change at 6 months: aerobic training (n=15): 6.85 (12.6) vs no training (n=10): -11.48 (11.1). Mean difference [95% CI]: 18.33 [8.95, 27.71] Mean (SD) change at 6 months: anaerobic training (n=8): 6.22 (13.7) vs no training (n=10): -11.48 (11.1). Mean difference [95% CI]: 17.70 [5.98, 29.42] Mean (SD) change at 6 months off training: aerobic training (n=14): 0.16 (13.1) vs no training (n=8): -9.35 (12.1). Mean difference [95% CI]: 9.51 [-1.32, 20.34] Mean (SD) change at 6 months off training: anaerobic	Incomplete outcome data (attrition bias) (all outcomes): Unclear risk (3 participants dropped out at the start of programme: 1 from training group due to failure to attend on initial assessment; and 2 in the control group were withdrawn due to ill health. A further 6 participants dropped out during the 1-year period. Reasons for dropout were not clearly reported After 1 year, overall dropout rate was 18% and balanced among the groups (19% in the intervention and 15% in the control group) Intention-to-treat analysis was not performed. Missing data were treated by omission and only data for those who completed study presented)

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				training (n=8): 2.24 (13.6) vs no training (n=8): -9.35 (12.1). Mean difference [95% CI]: 11.59 [-1.02, 24.20] Mean (SD) change at 18 months off training: aerobic training (n=11): -4.5 (13.8) vs no training (n=7): -7.36 (12.9). Mean difference [95% CI]: 2.86 [-9.70, 15.42] Mean (SD) change at 18 months off training: anaerobic training (n=8): 1.9 (13.8) vs no training (n=7): -7.36 (12.9). Mean difference [95% CI]: 9.26 [-4.26, 22.78] Time to next exacerbation Not reported Quality of life Not reported Preference for training programme Not reported Body composition Mean (SD) change in BMI (kg/m2) at 3	Selective reporting (reporting bias): Low risk (All outcome detailed in methods were reported in results. Data reported for all time-points) Other bias: Low risk (Clearly stated inclusion and exclusion criteria and describe method of statistical analysis used) Rovedder 2014 Random sequence generation (selection bias): Low risk (Participants were randomly allocated in blocks of 6 to the exercise or control group. A computer programme was used to generate randomisation sequence) Allocation concealment (selection bias): Unclear risk (Not discussed) Blinding of participants and personnel

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				months: aerobic training (n=15): 0 (0.6) vs no training (n=10): -0.3 (0.5). Mean difference [95% CI]: 0.30 [-0.13, 0.73]. Mean (SD) change in BMI (kg/m2) at 3 months: anaerobic training (n=15): 0.2 (0.6) vs no training (n=10): -0.3 (0.5). Mean difference [95% CI]: 0.50 [0.07, 0.93] Mean (SD) change in BMI (kg/m2) at 6 months: aerobic training (n=15): 0 (0.5) vs no training (n=10): -0.4 (0.5). Mean difference [95% CI]: 0.40 [0.00, 0.80]. Mean (SD) change in BMI (kg/m2) at 6 months: anaerobic training (n=15): 0.3 (0.6) vs no training (n=10): -0.4 (0.5). Mean difference [95% CI]: 0.70 [0.27, 1.13]	(performance bias) (all outcomes): Unclear risk (Not possible to blind participants to intervention. One researcher was blinded to the randomisation and intervention and was responsible for database entries) Blinding of outcome assessment (detection bias) (all outcomes): Low risk (Outcome assessors were blinded) Incomplete outcome data (attrition bias) (all outcomes): Low risk (2 participants in the exercise group could not be assessed at the 3-month visit due to submission to the lung transplant programme Intention-to-treat analysis was used and imputations for missing data were performed for these 2 participants)

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				Mean (SD) change in BMI (kg/m2) at 6 months off training: aerobic training (n=15): 0.1 (0.5) vs no training (n=8): -0.4 (0.6). Mean difference [95% CI]: 0.50 [0.01, 0.99]. Mean (SD) change in BMI (kg/m2) at 6 months off training: anaerobic training (n=15): 0.7 (1) vs no training (n=8): -0.4 (0.6). Mean difference [95% CI]: 1.10 [0.45, 1.75] Mean (SD) change in BMI (kg/m2) at 18 months off training: aerobic training (n=12): 0 (0.8) vs no training (n=7): -0.4 (0.9). Mean difference [95% CI]: 0.40 [-0.37, 1.17]. Mean (SD) change in BMI (kg/m2) at 18 months off training: anaerobic training (n=12): 0.9 (1.3) vs no training (n=8): -0.4 (0.9). Mean	Selective reporting (reporting bias): Low risk (All outcome detailed in methods were reported in results. Data reported for all time-points) Other bias: Unclear risk (Clearly stated inclusion and exclusion criteria and described method of statistical analysis used. Baseline between-group differences existed in BMI which could possibly impact on HRQoL (primary outcome) Santana_Sosa 2012 Random sequence generation (selection bias): Unclear risk (Participants were randomly assigned to exercise or control group with a block on gender based on the randomisation sequence. No details about how

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				difference [95% CI]: 1.30 [0.34, 2.26] Adverse events Not reported Moorcroft 2004 FEV1 % predicted Not reported FEV1 (mL) Mean difference (SE) in annual change at 12 months for combined aerobic and anaerobic training vs no training: 107 (92.34). Mean difference [95% CI]: 107.00 [-73.98, 287.98] FVC % predicted Not reported FVC (mL) Mean difference (SE) in annual change at 12 months for combined aerobic and anaerobic training vs no training: 213 (107.14). Mean difference [95% CI]: 213.00 [3.01, 422.99]	randomisation sequence was generated) Allocation concealment (selection bias): Unclear risk (Not discussed) Blinding of participants and personnel (performance bias) (all outcomes): Unclear risk (Not possible to blind participants to intervention. Personnel involved in training not blinded) Blinding of outcome assessment (detection bias) (all outcomes): Low risk (Outcome assessors were blinded to participants group assignment) Incomplete outcome data (attrition bias) (all outcomes): High risk (Clear description of missing outcome data. 5 participants

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				VO2 Not reported Time to next exacerbation Not reported Quality of life Not reported Preference for training programme Not reported Body composition Mean difference (SE) in annual change in BMI (kg/m2) for combined aerobic and anaerobic training vs no training: 0.54 (0.32). Mean difference [95% CI]: 0.54 [-0.09, 1.17] Adverse events Not reported Rovedder 2014 FEV1 % predicted Mean (SD) change at 3 months: combined aerobic and anaerobic training (n=19): -6 (16.1) vs no training (n=22): -2 (7.3). Mean difference [95% CI]: FVC (mL	could not be assessed at different time points (1 post-intervention and 4 after detraining) due to hospitalisations (n = 3), relocation (n = 1) and parents who declined further evaluation (n = 1). Dropout rate was unbalanced with 28% in the control group and 9% in the intervention group after the detraining period. Intention-to-treat analysis was used and missing outcome data (at post-training or detraining visit) were replaced by baseline data) Selective reporting (reporting bias): Low risk (All outcomes detailed in methods were reported in results. Data reported for all time-points) Other bias: High risk (Some raw data were made

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				FVC % predicted Mean difference (SE) in change at 3 months for combined aerobic and anaerobic training vs no training: -3.3 (4.3). Mean difference [95% CI]: -3.30 [-11.73, 5.13] VO2 Not reported Time to next exacerbation Not reported Quality of life, change* at 3 months HRQoL scale - physical (median (interquartile range)): Exercise group (n=19): 6.1 (-4 to 8) vs Control group (n=22): 2.4 (-10 to 13); p value: 0.742 HRQoL scale - body image (median (interquartile range)): Exercise group (n=19): 3.3 (-11 to 22) vs Control group (n=22): 3.0 (-2 to 11); p value: 0.915	available, but there were inconsistencies between raw data and data reported in the original publication. There were significant between-group differences in primary (VO2 peak) and secondary (strength measures) outcome measures at baseline) Santana-Sosa 2014 Random sequence generation (selection bias): Unclear risk (Randomisation to intervention or control group with block on gender. No details given for sequence generation) Allocation concealment (selection bias): Unclear risk (Not discussed) Blinding of participants and personnel (performance bias)

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				HRQoL scale - digestive (median (interquartile range)): Exercise group (n=19): -1.0 (-4 to 0) vs Control group (n=22): -0.5 (0 to 0); p value: 0.953 HRQoL scale - respiratory (median (interquartile range)): Exercise group (n=19): 3.8 (0 to 11) vs Control group (n=22): -4.7 (-1 to 7); p value: 0.925 HRQoL scale - emotional (median (interquartile range)): Exercise group (n=19): 1.2 (-6 to 6) vs Control group (n=22): -4.3 (-13 to 6); p value: 0.458 HRQoL scale - social (median (interquartile range)): Exercise group (n=19): -1.1 (-11 to 5) vs Control group (n=22): -1.7 (-5 to 11); p value: 0.822 HRQoL scale - food (median	(all outcomes): Unclear risk (Not possible to blind participants to intervention. Personnel involved in training not blinded) Blinding of outcome assessment (detection bias) (all outcomes): Low risk (Outcome assessors were blinded to participants group assignment) Incomplete outcome data (attrition bias) (all outcomes): High risk (Clear description of missing outcome data. 3 participants of the control group could not be assessed at different time points (1 for post-intervention and detraining phase and 2 after detraining phase) due to hospitalisation for lung transplantation

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				(interquartile range)): Exercise group (n=19): -0.3 (-11 to 6) vs Control group (n=22): -2.0 (-11 to 0); p value: 0.913 HRQoL scale - treatment (median (interquartile range)): Exercise group (n=19): -2.0 (-11 to 0) vs Control group (n=22): -2.5 (-11 to 11); p value: 0.850 HRQoL scale - vitality (median (interquartile range)): Exercise group (n=19): -1.2 (-16 to 8) vs Control group (n=22): 2.6 (-8 to 10); p value: 0.579 HRQoL scale - health (median (interquartile range)): Exercise group (n=19): 1.7 (-11 to 16) vs Control group (n=22): -3.0 (-11 to 0); p value: 0.382 HRQoL scale - weight (median (interquartile	preparation (n = 1), infection with Burkholderia cepacia (n = 1) and refusal (n = 1). Unbalanced distribution of dropouts. Drop out rate in the control group was 30% versus none in the intervention group Intention-to-treat analysis was reported, but it is not clear how missing data were handled) Selective reporting (reporting bias): Low risk (All outcome detailed in methods were reported in results. Data reported for all time points) Other bias: High risk (Some raw data were made available, but there were inconsistencies between raw data and data reported in the original publication. Significant

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				range)): Exercise group (n=19): 4.6 (0 to 33) vs Control group (n=22): 12.1 (0 to 11); p value: 0.410 HRQoL scale - social role (median (interquartile range)): Exercise group (n=19): 0.8 (-8 to 8) vs Control group (n=22): 1.8 (-2 to 0); p value: 0.935 Preference for training programme Not reported Body composition Not reported Adverse events Not reported Santana-Sosa 2012 FEV1 % predicted Not reported FEV1 (litres) Mean (SE): Intervention pre-training: 1.87 (0.24); Intervention post-training: 1.94 (0.23); Intervention detraining: 1.90 (0.25) vs control pre-training: 1.77 (0.17); control post-training: 1.87 (0.15);	between-group differences in primary outcomes (VO2 peak and strength measures) existed at baseline. Schneiderman-Walker 2000 Random sequence generation (selection bias): Low risk (Computer-generated randomisation sequence) Allocation concealment (selection bias): Unclear risk (Not discussed) Blinding of participants and personnel (performance bias) (all outcomes): Unclear risk (Not possible to blind participants to intervention. Unclear whether personnel was blinded). Blinding of outcome assessment (detection bias) (all outcomes): Low

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				control detraining: 1.79 (0.19) FVC % predicted Not reported FVC (litres) Mean (SE): Intervention pre-training: 2.41 (0.24); Intervention post-training: 2.49 (0.25); Intervention detraining: 2.56 (0.29) vs control pre-training: 2.29 (0.19); control post-training: 2.36 (0.20); control detraining: 2.40 (0.24) VO2 peak (mean (95% CI)) ml/min per kg body weight Intervention: Intervention pre-training: n.a.; Intervention post-training: 3.9 (1.8 to 6.1); Intervention detraining: -3.4 (-5.7 to 1.7) vs control pre-training: n.a.; control post-training: -2.2 (-5.3 to 0.1); control detraining: -0.7 (-4.4 to 5.9) Time to next exacerbation	risk (Pulmonary function assessors were blinded to group assignment (primary outcome measure) Incomplete outcome data (attrition bias) (all outcomes): Unclear risk (Clear description and details about 7 dropouts were recorded Intention-to-treat analysis was reported to yield similar results for pulmonary function. Results were only reported for 65 participants who completed the 2-year follow up) Selective reporting (reporting bias): Low risk (All outcome detailed in methods were reported in results. Data reported for all time points) Other bias: Unclear risk (Groups similar at baseline. Stated the inclusion criteria but not the

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				Not reported Quality of life (HRQoL score) Median (range) for children's report: intervention pre-training: 696 (495 - 741); intervention post-training: 719 (550 - 734); vs control pre-training: 649 (578 - 768); control post-training: 638 (461 - 791) Median (range) for parents' report: intervention pre-training: 896 (688-1011); intervention post-training: 889 (811 - 973); vs control pre-training: 911 (842 - 1028); control post-training: 978 (684 - 1059) Preference for training programme Not reported Body composition Mean (SE) weight (kg): Intervention pre-training: 39.9 (3.5); Intervention post-training: 40.5 (3.4); Intervention detraining: 41.4	exclusion criteria. Described statistical methods used in analysis) Selvadurai 2002 Random sequence generation (selection bias): Unclear risk (Random allocation in sets of 6. No details given for generation of sequence) Allocation concealment (selection bias): Low risk (Concealed information inside opaque envelopes) Blinding of participants and personnel (performance bias) (all outcomes): Unclear risk (Not possible to blind participants to intervention. Unclear whether personnel was blinded) Blinding of outcome assessment (detection bias) (all outcomes): Unclear

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				(3.4) vs control pre-training: 34.0 (2.6); control post-training: 35.1 (2.8); control detraining: 36.2 (3.0) Mean (SE) BMI (kg/m2): Intervention pre-training: 18.4 (1.0); Intervention post-training: 18.3 (0.7); Intervention detraining 18.5 (0.7): vs control pre-training: 17.2 (0.8); control post-training: 17.1 (0.8); control detraining: 17.4 (0.9) Adverse events No adverse effects occurred during training or maximal exercise testing Santana-Sosa 2014 FEV1 % predicted Not reported FEV1 (litres) Mean (SE): Intervention pre-training: 1.65 (0.19); Intervention post-training: 1.74 (0.23); Intervention detraining: vs	risk (Unclear whether outcome assessors were blinded) Incomplete outcome data (attrition bias) (all outcomes): Low risk (Stated no dropouts) Selective reporting (reporting bias): Unclear risk (Did not report on all secondary outcomes detailed in methods (e.g. VE, VCO2, RQ) in results. Data reported for all time-points. Other bias: Low risk (Clearly stated inclusion and exclusion criteria. Described statistical methods used to analyse data). Other information

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				control pre-training: 1.57 (0.26); control post-training: 1.55 (0.26); control detraining: 1.59 (0.26) FVC % predicted Not reported FVC (litres) Mean (SE): Intervention pre-training: 2.23 (0.27); Intervention post-training: 2.34 (0.29); Intervention detraining: 2.28 (0.28) vs control pre-training: 1.90 (0.33); control post-training: 1.85 (0.32); control detraining: 1.92 (0.32) VO2 Mean (95% CI): Intervention pre-training: n.a.; Intervention post-training: 6.9 (3.4 to 10.5); Intervention detraining: -1.5 (-2.7 to -0.4) vs control pre-training: n.a.; control post-training: n.a.; control detraining:n.a.	

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				Time to next exacerbation Not reported Quality of life Median (min-max): Intervention pre-training: 629 (505 - 701); Intervention post-training: 688 (609 - 791); Intervention detraining: not assessed; vs control pre-training: 636 (626 - 745); control post-training: 638 (626 - 737); control detraining: not assessed Preference for training programme Not reported Body composition Mean (SE) weight (kg): Intervention pre-training: 36.4 (3.1); Intervention post-training: 37.8 (3.2); Intervention detraining: 38.3 (3.1) vs control pre-training: 31.5 (4.6); control post-training: 32.4 (4.7); control detraining: 32.7 (4.5)	

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				Adverse events No adverse effects occurred during training or exercise testing Schneiderman-Walker 2000 FEV1 % predicted Mean (SD) annual rate of change over 36 months: aerobic training (n=30): -1.46 (3.55) vs no training (n=35): -3.47 (4.93). Mean difference: 2.01 [-0.06, 4.08] FVC % predicted Mean (SD) annual rate of change over 36 months: aerobic training (n=30): -0.25 (2.81) vs no training (n=35): -2.42 (4.15). Mean difference: 2.17 [0.47, 3.87] VO2 Not reported Time to next exacerbation Not reported Quality of life Not reported	

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				Preference for training programme Not reported Body composition Mean (SD) annual rate of change in ideal weight for height (%) over 36 months: aerobic training (n=30): 0.48 (2.52) vs no training (n=35): -0.04 (2.75). Mean difference: 0.52 [-0.76, 1.80] Adverse events Not reported Selvadurai 2002 FEV1 % predicted Mean (SD) change at hospital discharge: aerobic training (n=22): 6.54 (7.76) vs no training (n=22): 4.51 (6.9). Mean difference [95% CI]: 2.03 [-2.31, 6.37] Mean (SD) change at hospital discharge: anaerobic training (n=22): 10.09 (7.43) vs no training (n=22): 4.51 (6.9). Mean difference	

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				[95% CI]: 5.58 [1.34, 9.82] Mean (SD) change at 1 month after hospital discharge: aerobic training (n=22): 6.25 (7.94) vs no training (n=22): 4.72 (7.15). Mean difference [95% CI]: 1.53 [-2.93, 5.99] Mean (SD) change at 1 month after hospital discharge: anaerobic training (n=22): 9.8 (7.81) vs no training (n=22): 4.72 (7.15). Mean difference [95% CI]: 5.08 [0.66, 9.50] FVC % predicted Mean (SD) change at hospital discharge: aerobic training (n=22): 2.34 (4.62) vs no training (n=22): 2.28 (4.22). Mean difference [95% CI]: 0.06 [-2.55, 2.67] Mean (SD) change at hospital discharge: anaerobic training (n=22):	

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				2.45 (4.18) vs no training (n=22): 2.28 (4.22). Mean difference [95% CI]: 0.17 [-2.31, 2.65] Mean (SD) change at 1 month after hospital discharge: aerobic training (n=22): 2.2 (4.27) vs no training (n=22): 2.31 (4.29). Mean difference [95% CI]: -0.11 [-2.64, 2.42] Mean (SD) change at 1 month after hospital discharge: anaerobic training (n=22): 2.37 (4.09) vs no training (n=22): 2.31 (4.29). Mean difference [95% CI]: 0.06 [-2.42, 2.54] VO2 peak during maximal exercise (ml/min per kg BW) Mean (SD) change at hospital discharge: aerobic training (n=22): 7.31 (6.29) vs no training (n=22): -1.22 (6.15).	

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				Mean difference [95% CI]: 8.53 [4.85, 12.21] Mean (SD) change at hospital discharge: anaerobic training (n=22): 0.73 (5.89) vs no training (n=22): -1.22 (6.15). Mean difference [95% CI]: 1.95 [-1.61, 5.51] Mean (SD) change at 1 month after hospital discharge: aerobic training (n=22): 7.56 (6.75) vs no training (n=22): 2.65 (6.02). Mean difference [95% CI]: 8.53 [4.85, 12.21] Mean (SD) change at 1 month after hospital discharge: anaerobic training (n=22): 2.25 (6.25) vs no training (n=22): 2.65 (6.02). Mean difference [95% CI]: -0.40 [-4.03, 3.23] Time to next exacerbation Not reported	

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				Quality of life Mean (SD) change in health-related quality of life at 1 month after discharge: aerobic training (n=22): 0.09 (0.12) vs no training (n=22): -0.01 (0.12). Mean difference [95% CI]: 0.10 [0.03, 0.17] Mean (SD) change in health-related quality of life at 1 month after discharge: anaerobic training (n=22): 0.02 (0.1) vs no training (n=22): -0.01 (0.12). Mean difference [95% CI]: 0.03 [-0.04, 0.10] Preference for training programme Not reported Body composition Mean (SD) change in body weight (kg) at hospital discharge: aerobic training (n=22): 0.8 (0.64) vs no training (n=22): 1.03 (0.58). Mean difference	

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				[95% CI]: -0.23 [-0.59, 0.13] Mean (SD) change in body weight (kg) at hospital discharge: anaerobic training (n=22): 2.76 (0.7) vs no training (n=22): 1.03 (0.58). Mean difference [95% CI]: 1.73 [1.35, 2.11] Mean (SD) change at 1 month after hospital discharge: aerobic training (n=22): 1.1 (0.78) vs no training (n=22): 1 (0.66). Mean difference [95% CI]: 0.10 [-0.33, 0.53] Mean (SD) change in body weight (kg) at 1 month after hospital discharge: anaerobic training (n=22): 2.65 (0.73) vs no training (n=22): 1 (0.66). Mean difference [95% CI]: 1.65 [1.24, 2.06] Adverse events Not reported	

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
				*Extracted from individual paper	
Full citation Rovedder, P. M., Flores, J., Ziegler, B., Casarotto, F., Jaques, P., Barreto, S. S., et al.,, Exercise programme in patients with cystic fibrosis: a randomized controlled trial, Respiratory Medicine, 108, 1134-40, 2014 Ref Id 426131 Country/ies where the study was carried out See Radtke 2015 Study type See Radtke 2015 Aim of the study See Radtke 2015 Study dates See Radtke 2015 Source of funding See Radtke 2015	Sample size See Radtke 2015 Characteristics See Radtke 2015 Inclusion criteria See Radtke 2015 Exclusion criteria See Radtke 2015	Interventions See Radtke 2015	Details See Radtke 2015	Results See Radtke 2015	Limitations See Radtke 2015 Other information See Radtke 2015

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Full citation Santana-Sosa, E., Gonzalez-Saiz, L., Groeneveld, I. F., Villa-Asensi, J. R., Barrio Gomez de Aguero, M. I., Fleck, S. J., Lopez-Mojares, L. M., Perez, M., Lucia, A., Benefits of combining inspiratory muscle with 'whole muscle' training in children with cystic fibrosis: a randomised controlled trial, British Journal of Sports Medicine, 48, 1513-7, 2014 Ref Id 366701 Country/ies where the study was carried out See Radtke 2015 Study type See Radtke 2015 Aim of the study See Radtke 2015 Study dates See Radtke 2015 Source of funding See Radtke 2015	Sample size See Radtke 2015 Characteristics See Radtke 2015 Inclusion criteria See Radtke 2015 Exclusion criteria See Radtke 2015	Interventions See Radtke 2015	Details See Radtke 2015	Results See Radtke 2015	Limitations See Radtke 2015 Other information See Radtke 2015

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Full citation Schindel, C. S., Hommerding, P. X., Melo, D. A. S., Baptista, R. R., Marostica, P. J. C., Donadio, M. V. F., Physical exercise recommendations improve postural changes found in children and adolescents with cystic fibrosis: A randomized controlled trial, Journal of Pediatrics, 166, 710-716, 2015 Ref Id 426159 Country/ies where the study was carried out Brazil Study type RCT Aim of the study To evaluate the effects of an educational guideline for physical activity on body posture in children and	Sample size N= 34 intervention: n=17 control: n=17 Characteristics People with CF. Age range: 7 to 20 years Mean (SD) age in intervention group: 13.6 (2.8) years Mean (SD) age in control group: 12.9 (3.9) years Females: 41.2% Inclusion criteria People with CF aged 7 to 20 years with clinically stable disease who were regularly followed at the CF outpatient clinic. Exclusion criteria Children and adolescents with cognitive alterations or osteomuscular changes that would make it impossible to perform the tests.	Interventions Intervention: aerobic exercise and stretching for 3 months unsupervised programme instruction handbook calendar where patients marked the days they performed exercise at least 3 times per week for a minimum of 20 minutes and perform each stretch 2 times for 20 seconds each phone calls from the researcher every two weeks Control: usual care for 3 months Verbal orientations to	Details Setting. CF outpatient clinic at Hospital São Lucas, Pontíficia Universidade Católica do Rio Grande do Sul (HSL-PUCRS). Randomization. Initially, 34 people with CF were selected, paired according to age, sex, height and weight to heathy subjects. In phase 2 people with CF were randomized to an intervention or a control group. A computer program (Random Allocation Software v 1.0; http://random-allocation-software.software.informer.com/1.0/) in blocks of 6 was used for the randomization process. Data collection. Measurements of clinical indicators were taken at the outpatient clinic at baseline and after 3 months. The researcher performing all evaluations was blinded to the group allocation.	Results FEV1 % predicted Mean (SD) change at 3 months: Intervention (n=17): -1.8 (8.6) vs control (n=17): 2.7 (12.8) FVC% predicted Mean (SD) change at 3 months: Intervention (N=17): -0.41(6.8) vs control (n=17): 1.8 (12.2) VO2 peak Not reported Quality of life Not reported Time to next exacerbation Not reported Body composition Not reported Preference for training programme Not reported Adverse events Not reported	Limitations The quality of the study was assessed using the Cochrane risk of bias tool: Random sequence generation (selection bias): Low risk (Randomization in blocks of 6 with a computer software) Allocation concealment (selection bias): Unclear risk (Not mentioned in text) Blinding of participants and personnel (performance bias) (all outcomes): Unclear risk (Not possible to blind participants to intervention. Unclear whether personnel was blinded) Blinding of outcome assessment (detection bias) (all outcomes): Low risk (Outcome

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
adolescents with CF. Study dates Not reported Source of funding C.S. was supported by a scholarship from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior.		perform exercise and stretching			assessor was blinded to the group allocation) Incomplete outcome data (attrition bias) (all outcomes): Low risk (Outcome data provided for all participants who were randomized) Selective reporting (reporting bias): Low risk (Lung function measurements mentioned in the method section and presented in the results section) Other bias: Low risk (none detected) Other information
Full citation Schneiderman-Walker, J., Pollock, S. L., Corey, M., Wilkes, D. D., Canny, G. J., Pedder, L., Reisman, J. J., A randomized controlled trial of a 3-year home exercise program in	Sample size See Radtke 2015 Characteristics See Radtke 2015 Inclusion criteria See Radtke 2015 Exclusion criteria See Radtke 2015	Interventions See Radtke 2015	Details See Radtke 2015	Results See Radtke 2015	Limitations See Radtke 2015 Other information See Radtke 2015

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
cystic fibrosis, Journal of Pediatrics, 136, 304-10, 2000 Ref Id 333851 Country/ies where the study was carried out See Radtke 2015 Study type See Radtke 2015 Aim of the study See Radtke 2015 Study dates See Radtke 2015 Source of funding See Radtke 2015					
Full citation Selvadurai, H. C., Blimkie, C. J., Meyers, N., Mellis, C. M., Cooper, P. J., Van Asperen, P. P., Randomized controlled study of in-hospital exercise training programs in children with cystic fibrosis, Pediatric Pulmonology, 33, 194-200, 2002 Ref Id 331965	Sample size See Radtke 2015 Characteristics See Radtke 2015 Inclusion criteria See Radtke 2015 Exclusion criteria See Radtke 2015	Interventions See Radtke 2015	Details See Radtke 2015	Results See Radtke 2015	Limitations See Radtke 2015 Other information See Radtke 2015

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Country/ies where the study was carried out See Radtke 2015 Study type See Radtke 2015 Aim of the study See Radtke 2015 Study dates See Radtke 2015 Source of funding See Radtke 2015					
Full citation Santana Sosa, E., Groeneveld, I. F., Gonzalez-Saiz, L., Lopez-Mojares, L. M., Villa-Asensi, J. R., Barrio Gonzalez, M. I., Fleck, S. J., Perez, M., Lucia, A., Intrahospital weight and aerobic training in children with cystic fibrosis: a randomized controlled trial, Medicine & Science in Sports & Exercise, 44, 2-11, 2012 Ref Id 333844	Sample size See Radtke 2015 Characteristics See Radtke 2015 Inclusion criteria See Radtke 2015 Exclusion criteria See Radtke 2015	Interventions See Radtke 2015	Details See Radtke 2015	Results See Radtke 2015	Limitations See Radtke 2015 Other information See Radtke 2015

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Country/ies where the study was carried out See Radtke 2015 Study type See Radtke 2015 Aim of the study See Radtke 2015 Study dates See Radtke 2015 Source of funding See Radtke 2015					
Full citation Beaudoin, N., Bouvet, G. F., Coriati, A., Rabasa-Lhoret, R., Berthiaume, Y., Combined Exercise Training Improves Glycemic Control in Adult With Cystic Fibrosis, Medicine and Science in Sports and Exercise, 2016 Ref Id 537744 Country/ies where the study was carried out Canada Study type	Sample size N= 14 Exercise group: n=8 Control group: n=6 18 adults were recruited; 17 were randomized; 2 dropped out because of pulmonary exacerbations; 1 was excluded because he was noncompliant; therefore, 14 were included in the analysis Characteristics Adults with CF aged ≥18 years with glucose abnormality Exercise group (n=8): mean age 31.9; age range 24 to 41 Control group (n=6): mean age 35.5; age range 22 to 57 Inclusion criteria	Interventions Intervention: Combined aerobic and resistance training programme Unsupervised programme (supervised training session once every 4 weeks; received a phone call once a week) Both aerobic and resistance training: 3 times per	Details Study setting. CF clinic of the Centre Hospitalier de l'Universite de Montreal (CHUM) Randomization. Participants were recruited in a randomly assigned open label study. Randomization was conducted in block by gender with a ratio of 2:2. Data collection. Body weight and height were measured with light clothing and shoes removed. Pulmonary function was measured using the American Thoracic Society Standards and FEV1 (L/s-1), and the predicted % FEV1 was calculated using Nhanes III equation (Medgraphic 1870, St. Paul, MN). CPET was performed using a graded exercise test on an ergocycle, Ergoline 900 (Bitz, Germany), until voluntary exhaustion, and power output was increased by 5	Results FEV1 % predicted Mean (SD): exercise group at baseline (n=8): 70.50 (12.50); exercise group at 12 weeks (n=8): 69.25 (12.80); control group at baseline (n=6): 73.17 (14.62); control group at 12 weeks (n=6): 72.67 (17.66) FVC % predicted Mean (SD): exercise group at baseline(n=8): 87.88 (7.61); exercise group at 12 weeks (n=8): 87.50 (8.60); control group at baseline (n=6):	Limitations The quality of this study was assessed using the Cochrane risk of bias tool: Random sequence generation (selection bias): Low risk (randomization conducted in block by gender with a ratio 2:2) Allocation concealment (selection bias): Unclear risk (Not mentioned) Blinding of participants and personnel

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RCT Aim of the study To determine whether a combined exercise programme is beneficial to improve plasma glucose at 2h of the oral glucose tolerance test in cystic fibrosis. Study dates Participants were recruited between August 2013 and November 2014. Source of funding Not reported	sedentary (less than 100 min/wk-1 of structured exercise, assessed by physical activity questionnaire and phone interview) FEV1>40% clinically stable for the last 6 wk abnormal glucose tolerance (impaired glucose tolerance [IGT], CFRD without pharmacological treatment for diabetes, or elevated 1-h plasma glucose at the OGTT (indeterminate, 1-h OGTT >11.0 but 2-h OGTT< 7.8 mmol/L-1 [INDET]) Exclusion criteria current pulmonary exacerbation use of oral or intravenous corticosteroid known of low saturation (SpO2) during exercise history of hemoptysis in the last 6 wk	week for 12 weeks Aerobic training: 20 to 40 min; resistance training: 5 to 7 exercises for a progressively increasing number of sets and repetitions Control: no specific training	to 15 W every minute. During the CPET, expired gas samples were analyzed through a mixing chamber, and data were acquired breath by breath with 30 s time averaging, using a Moxus (AEI Technologies Inc., Naperville, IL) cardiorespiratory exercise test station. The highest 30-s average of oxygen uptake value obtained during the exercise test was considered as VO2peak. The CFQ-R was used to was administered before and after 12 weeks of protocol to measure quality of life. In order to monitor physical activity, participants wore a physical activity monitor, the SenseWear Armband Pro 3 (SWA; BodyMedia, Pittsburgh, PA), for 5 days, preintervention (before CEP) and postintervention, before the last training session. SWA was previously validated for the CF population and also against doubly labeled water for healthy adults.	97.35 (15.97); control group at 12 weeks (n=6): 93.67 (15.81) VO2 peak (ml/kg-1/min-1) Mean (SD): exercise group at baseline (n=8): 24.29 (5.16); exercise group at 12 weeks (n=8): 24.53 (4.01); control group at baseline (n=6): 22.98 (6.77); control group at 12 weeks (n=6): 25.35 (6.79) Quality of life Mean (SD) QoL physical functioning: exercise group at baseline (n=8): 72.68 (20.60); exercise group at 12 weeks (n=8): 80.20 (16.78); control group at baseline (n=6): 75.01 (26.07); control group at 12 weeks (n=6): 81.93 (16.82) Mean (SD) QoL vitality: exercise group at baseline (n=8): 55.20 (18.34); exercise group at 12 weeks (n=8): 58.33 (19.92); control	(performance bias) (all outcomes): Unclear risk (Not possible to blind participants to intervention. Unclear whether personnel was blinded)) Blinding of outcome assessment (detection bias) (all outcomes): Unclear risk (Not mentioned) Incomplete outcome data (attrition bias) (all outcomes): High risk (2 drop-outs because of pulmonary exacerbations; one patient was excluded because he was non-compliant) Selective reporting (reporting bias): Unclear risk (FVC % predicted and BMI are not mentioned in the methods section but are reported among the results in the

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				group at baseline (n=6): 54.18 (20.98); control group at 12 weeks (n=6): 54.18 (20.91) Mean (SD) QoL emotional state: exercise group at baseline (n=8): 88.33 (8.53); exercise group at 12 weeks (n=8): 81.66 (12.73); control group at baseline (n=6): 82.22 (13.11); control group at 12 weeks (n=6): 83.33 (15.06) Mean (SD) QoL eating disturbances: exercise group at baseline (n=8): 100 (0); exercise group at 12 weeks (n=8): 98.61 (3.92); control group at baseline (n=6): 100 (0); control group at 12 weeks (n=6): 100(0) Mean (SD) QoL treatment burden: exercise group at baseline (n=8): 70.85 (18.72); exercise group at 12 weeks (n=8):65.29 (28.14); control	supplementary material; weight, VO2 and QoL are mentioned in the methods section but the results are only reported in the supplementary material rather than in the main text) Other bias: Low risk (None detected) Other information

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				group at baseline (n=6): 68.52 (25.75); control group at 12 weeks (n=6): 68.52 (21.59) Mean (SD) QoL health perception: exercise group at baseline (n=8): 47.23 (26.42); exercise group at 12 weeks (n=8): 58.34 (23.59); control group at baseline (n=6): 57.42 (8.39); control group at 12 weeks (n=6): 74.10 (15.17) Mean (SD) QoL social limitations: exercise group at baseline (n=8): 77.78 (11.86); exercise group at 12 weeks (n=8): 75.28 (13.02); control group at baseline (n=6): 69.43 (16.77); control group at 12 weeks (n=6): 81.50 (18.13) Mean (SD) QoL body image: exercise group at baseline (n=8): 88.90 (8.39); exercise group at 12	

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				weeks (n=8): 84.74 (8.26); control group at baseline (n=6): 79.63 (20.40); control group at 12 weeks (n=6): 81.50 (18.13) Mean (SD) QoL role limitations: exercise group at baseline (n=8): 84.37 (18.08); exercise group at 12 weeks (n=8): 83.33 (25.20); control group at baseline (n=6): 90.29 (12.25); control group at 12 weeks (n=6): 84.73 (21.99) Mean (SD) QoL weight problems: exercise group at baseline (n=8): 95.84 (11.77); exercise group at 12 weeks (n=8): 87.50 (24.81); control group at baseline (n=6): 83.33 (40.82); control group at 12 weeks (n=6): 83.33 (40.82) Mean (SD) QoL respiratory symptoms: exercise group at baseline (n=8): 62.50 (14.47);	

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				exercise group at 12 weeks (n=8): 62.50 (14.47); control group at baseline (n=6): 61.12 (14.48); control group at 12 weeks (n=6): 65.75 (8.17) Mean (SD) QoL digestion symptoms: exercise group at baseline (n=8): 79.19 (9.26); exercise group at 12 weeks (n=8): 84.74 (10.17); control group at baseline (n=6): 77.78 (23.31); control group at 12 weeks (n=6): 68.53 (14.79) Time to next exacerbation Not reported Body composition Mean (SD) change in weight (kg): exercise group at baseline (n=8): 65.34 (15.52); exercise group at 12 weeks (n=8): 65.14 (16.07); control group at baseline (n=6): 65.98 (15.47); control group at 12	

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				weeks (n=6): 66.05 (14.92) Mean (SD) change in BMI (kg/m2): exercise group at baseline (n=8): 23.34 (3.61); exercise group at 12 weeks (n=8): 23.25 (3.76); control group at baseline (n=6): 24.24 (3.28); control group at 12 weeks (n=6): 24.09 (2.68) Adverse events Not reported	
Full citation Cox, N. S., Alison, J. A., Button, B. M., Wilson, J. W., Morton, J. M., Holland, A. E., Physical activity participation by adults with cystic fibrosis: An observational study, Respirology, 21, 511-8, 2016 Ref Id 469253 Country/ies where the study was carried out	Sample size N=61 Intervention 1: n=33 Control 1: n=28 Intervention 2: n=21 Control 2: n=40 65 adults were recruited; 4 were excluded because they wore the armband for insufficient time at baseline Characteristics Adults with CF aged ≥18 years Inclusion criteria Adults attending two specialist CF centres in	Interventions Comparison 1. Intervention 1: ≥30 minutes daily of habitual moderate-vigorous physical activity Control 1: <30 minutes daily of habitual moderate-vigorous physical activity	Details Setting. Two specialist CF centres in Melbourne. Recruitment. When attending a routine outpatient appointment, people were invited to participate in the study by a research physiotherapist not involved in their clinical care. Data collection. Physical activity was measured over 5-7 days using a portable multi-sensor armband, the SenseWear Pro3 Armband (SWA); the armband has been validated for assessing land-based PA intensity in adults with CF. Moderate physical activity intensity was classified as ≥4.8 metabolic equivalents. Data analysis. Physical activity data were	Results Need for hospitalization* Intervention 1: 16/33 vs control 1: 19/28 Intervention 2: 8/21 vs control 2: 26/40 *Please note that this was the only outcome that was extracted from this cohort study because this outcome can be considered a proxy for time to next exacerbation, which is a critical outcome	Limitations The quality of this study was assessed using the Newcastle-Ottawa scale assessment tool Selection of study population: High risk of bias Representativeness of the exposed cohort: Truly representative of the average people with CF that fit the inclusion criteria of the study

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Australia Study type Prospective cohort study Aim of the study To identify if there was a relationship between objectively measured physical activity levels and clinical outcomes, specifically lung function and hospitalization, over 12 months. Study dates Not reported Source of funding NSC was the recipient of a National Health and Medical Research Council (NH&MRC) PhD scholarship, a Cystic Fibrosis Australia PhD stipend, and grants from La Trobe University and the Thoracic Society of Australia and New Zealand (TSANZ).	Melbourne, Australia, with a confirmed diagnosis of CF Exclusion criteria Intravenous antibiotics for a respiratory exacerbation in the 4 weeks preceding baseline assessment co-morbidities limiting mobilization or physical activity participation colonization of respiratory secretions with Burkholderia cepacia; pregnancy lung transplant recipient Less than 3 days wear (for ≥10 hours in each day), of the armband used to measure physical activity	Comparison 2. Intervention 2: ≥30 minutes daily of habitual moderate-vigorous physical activity accumulated in bouts of > 10 minutes Control 2: <30 minutes or ≥30 minutes not accumulated in bouts of > 10 minutes	categorized based on the recommendations in physical activity guidelines, which recommend either 30 minutes of moderate-vigorous physical activity accumulated during the course of the day or 30 minutes of moderate-vigorous activity accumulated in bouts of at least 10 minutes duration. People were considered to have reached physical activity in bouts of at least 10 minutes duration if said bouts were recorded on any one day in the monitoring period.	that was not reported in any of the included RCTs.	Selection of the non-exposed cohort: Drawn from the same community as the exposed cohort Ascertainment of exposure: the authors write that it is possible that some participants performed more activity than the norm during the days of monitoring; moreover the armband only records land-based activity; the monitoring device was considered unfashionable by a number of participants, possibly reducing wear-time Demonstration that outcome of interest was not present at the start of the study: Yes (one of the exclusion criteria was intravenous antibiotics for a respiratory exacerbation in the

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					4 weeks preceding baseline assessment) Comparability: High risk of bias The study does not control for any factor in relation to the comparison of interest Assessment of outcome: Low risk of bias The outcome was assessed by record linkage. The follow-up (12 months) was long enough for the outcome to occur. All subjects (except 4 subjects excluded at baseline) accounted for during follow-up Other information