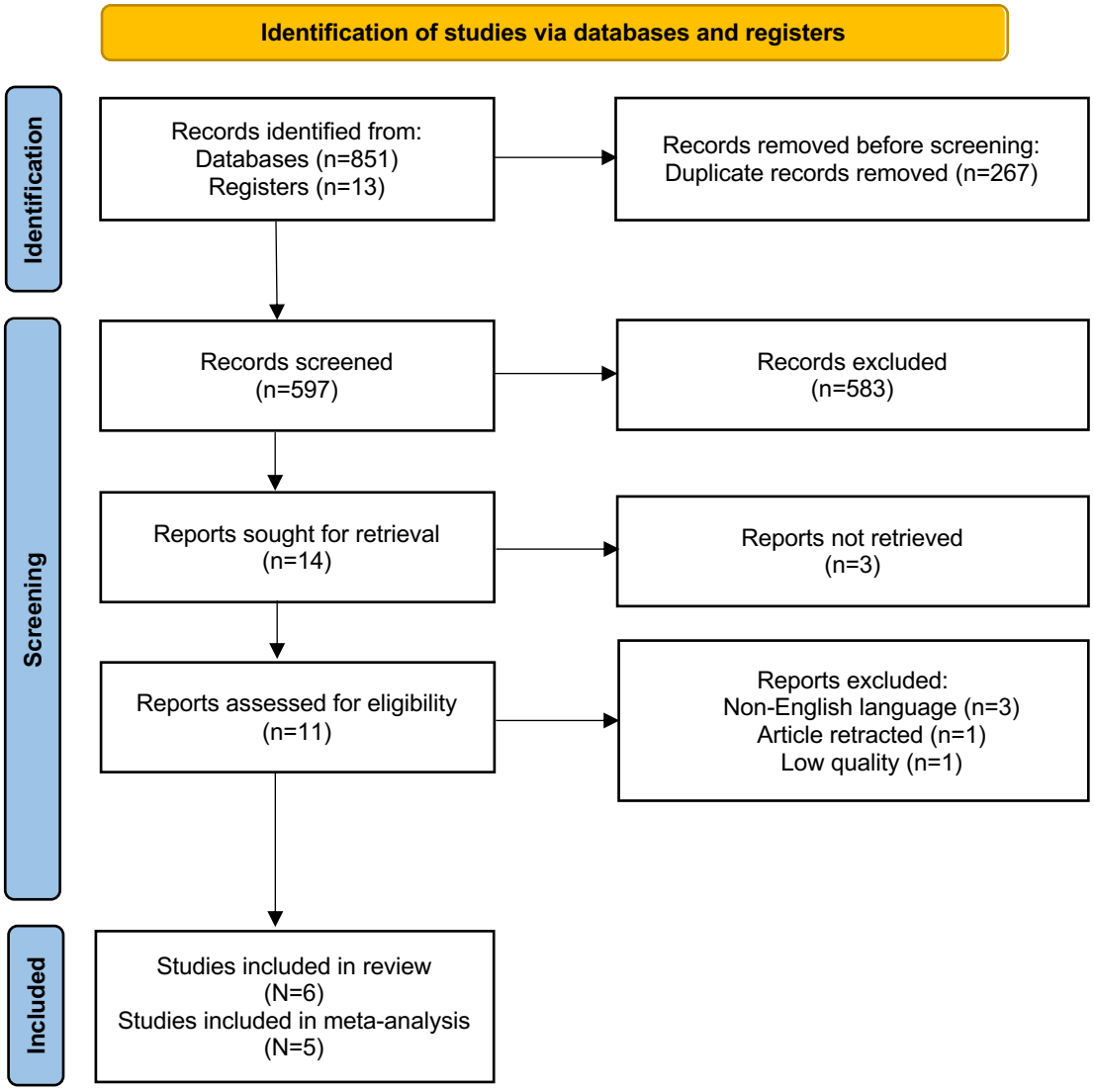
PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only



Supplementary materials:

Reporting checklist for systematic reviews, based on the PRISMA guidelines

		Reporting Item	Page Number
Title			
Title	#1	Identify the report as a systematic review	1
Abstract			
Abstract	#2	Report an abstract addressing each item in the PRISMA 2020 for Abstracts checklist	1
Introduction			
Background/rationale	#3	Describe the rationale for the review in the context of existing knowledge	3
Objectives	#4	Provide an explicit statement of the objective(s) or question(s) the review addresses	3
Methods			
Eligibility criteria	#5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses	4
Information sources	#6	Specify all databases, registers, websites, organisations, reference lists, and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted	4
Search strategy	#7	Present the full search strategies for all databases, registers, and websites, including any filters and limits used	4

Selection process	#8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and, if applicable, details of automation tools used in the process	4, 5
Data collection process	#9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and, if applicable, details of automation tools used in the process	5
Data items	#10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (for example, for all measures, time points, analyses), and, if not, the methods used to decide which results to collect	5
Study risk of bias assessment	#11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and, if applicable, details of automation tools used in the process	5

Effect measures	#12	Specify for each outcome the effect measure(s) (such as risk ratio, mean difference) used in the synthesis or presentation of results	5, 6
Synthesis methods	#13a	Describe the processes used to decide which studies were eligible for each synthesis (such as tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5))	5, 6
Synthesis methods	#13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics or data conversions	5, 6
Synthesis methods	#13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses	5, 6
Synthesis methods	#13d	Describe any methods used to synthesise results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used	6
Synthesis methods	#13e	Describe any methods used to explore possible causes of heterogeneity among study results (such as subgroup analysis, meta-regression)	6
Synthesis methods	#13f	Describe any sensitivity analyses conducted to assess robustness of the synthesised results	6

Reporting bias assessment	#14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases)	6
Certainty assessment	#15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome	6
Data items	#10b	List and define all other variables for which data were sought (such as participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information	5
Results			
Study selection	#16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram (http://www.prisma-statement.org/PRISMAStatement/FlowDiagram)	6
Study selection	#16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded	6
Study characteristics	#17	Cite each included study and present its characteristics	6
Risk of bias in studies	#18	Present assessments of risk of bias for each included study	7

Results of individual studies	#19	For all outcomes, present for each study (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (such as confidence/credible interval), ideally using structured tables or plots	7, 8
Results of syntheses	#20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies	7, 8
Results of syntheses	#20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (such as confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect	7, 8
Results of syntheses	#20c	Present results of all investigations of possible causes of heterogeneity among study results	7, 8
Results of syntheses	#20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesised results	7, 8
Risk of reporting biases in syntheses	#21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed	7, 8
Certainty of evidence	#22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed	7, 8
Discussion			

Results in context	#23a	Provide a general interpretation of the results in the context of other evidence	8
Limitations of included studies	#23b	Discuss any limitations of the evidence included in the review	9, 10
Limitations of the review methods	#23c	Discuss any limitations of the review processes used	9, 10
Implications	#23d	Discuss implications of the results for practice, policy, and future research	9, 10
Other information			
Registration and protocol	#24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered	4
Registration and protocol	#24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared	n/a
Registration and protocol	#24c	Describe and explain any amendments to information provided at registration or in the protocol	n/a
Support	#25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review	10
Competing interests	#26	Declare any competing interests of review authors	10
Availability of data, code, and other materials	#27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review	10

Search details

- **Cochrane Library**
  Advanced Search
  ID Search Hits
  #1 MeSH descriptor: [Pulmonary Disease, Chronic Obstructive] explode all trees

  #2 MeSH descriptor: [Virtual Reality] explode all trees
  #3 MeSH descriptor: [Video Games] explode all trees
  #4 #1 AND (#2 OR #3)
  #5 ("Reality, Virtual" OR "Virtual Reality" OR "Virtual Realities" OR "Reality, Educational Virtual" OR "Realities, Instructional Virtual" OR "Reality, Instructional Virtual" OR "VR" OR “active video*” OR “interactive video” OR “virtual reality” OR “exergam*” OR “active play” OR “computer gam*” OR “video gam*” OR “gamification” OR “digital gam*” OR “rehabilitation gam*” OR “Nintendo Wii” OR “PlayStation” OR “Eye Toy” OR “Xbox” OR “Kinect”) AND ("Chronic Obstructive Lung Disease" OR "Chronic Obstructive Pulmonary Diseases" OR "COAD" OR "COPD" OR "Chronic Obstructive Airway Disease" OR "Chronic Obstructive Pulmonary Disease" OR "Airflow Obstruction, Chronic" OR "Airflow Obstructions, Chronic" OR "Chronic Airflow Obstructions" OR "Chronic Airflow Obstruction")
  #6 #4 OR #5

- **Pubmed**
  Advanced Search
  ("reality virtual"[All Fields] OR "Virtual Reality"[All Fields] OR "Virtual Realities"[All Fields] OR ("Virtual Reality"[MeSH Terms] OR ("virtual"[All Fields] AND "reality"[All Fields]) OR "Virtual Reality"[All Fields] OR ("reality"[All Fields] AND "educational"[All Fields] AND "virtual"[All Fields])) OR ("Virtual Reality"[MeSH Terms] OR ("virtual"[All Fields] AND "reality"[All Fields]) OR "Virtual Reality"[All Fields] OR ("realities"[All Fields] AND "instructional"[All Fields] AND "virtual"[All Fields])) OR ("Virtual Reality"[MeSH Terms] OR ("virtual"[All Fields] AND "reality"[All Fields]) OR "Virtual Reality"[All Fields] OR ("reality"[All Fields] AND "instructional"[All Fields] AND "virtual"[All Fields])) OR "VR"[All Fields] OR "active video*"[All Fields] OR "interactive video"[All Fields] OR "Virtual Reality"[All Fields] OR "exergam*"[All Fields] OR "active play"[All Fields] OR "computer gam*"[All Fields] OR "video gam*"[All Fields] OR "gamification"[All Fields] OR "digital gam*"[All Fields] OR "rehabilitation gam*"[All Fields] OR "Nintendo Wii"[All Fields] OR "PlayStation"[All Fields] OR (("eye"[MeSH Terms] OR "eye"[All Fields]) AND "toy"[All Fields]) OR "Xbox"[All Fields] OR "Kinect"[All Fields]) AND ("Chronic Obstructive Lung Disease"[All Fields] OR "Chronic Obstructive Pulmonary Diseases"[All Fields] OR "COAD"[All Fields] OR "COPD"[All Fields] OR "Chronic Obstructive Airway Disease"[All Fields] OR "Chronic Obstructive Pulmonary Disease"[All Fields] OR "airflow obstruction chronic"[All Fields] OR "airflow obstructions chronic"[All Fields] OR "Chronic Airflow Obstructions"[All Fields] OR "Chronic Airflow Obstruction"[All Fields])

- **Scopus**
  (TITLE-ABS-KEY (("reality, virtual" OR "virtual reality" OR "virtual realities" OR "reality, educational virtual" OR "realities, instructional virtual" OR "reality, instructional virtual" OR "VR" OR "active video*" OR "interactive video" OR "virtual reality" OR "exergam*" OR "active play" OR "computer gam*" OR "video gam*" OR "gamification" OR "digital gam*" OR "rehabilitation gam*" OR "nintendo wii" OR "playstation" OR "eye toy" OR "xbox" OR

"kinect"))) AND (TITLE-ABS-KEY (("chronic obstructive lung disease" OR "chronic obstructive pulmonary diseases" OR "coad" OR "copd" OR "chronic obstructive airway disease" OR "chronic obstructive pulmonary disease" OR "airflow obstruction, chronic" OR "airflow obstructions, chronic" OR "chronic airflow obstructions" OR "chronic airflow obstruction")))

- **Embase**

  #1. 'virtual reality'/exp OR 'virtual reality' OR 'video game'/exp OR 'tv games' OR 'computer game' OR 'computergame' OR 'television game' OR 'video game' OR 'video games' OR 'videogame' OR 'videogames'

  #2. 'chronic obstructive lung disease'/exp OR 'chronic airflow obstruction' OR 'chronic airway obstruction' OR 'chronic obstructive bronchopulmonary disease' OR 'chronic obstructive lung disease' OR 'chronic obstructive lung disorder' OR 'chronic obstructive pulmonary disease' OR 'chronic obstructive pulmonary disorder' OR 'chronic obstructive respiratory disease' OR 'chronic pulmonary obstructive disease' OR 'chronic pulmonary obstructive disorder' OR 'copd' OR 'lung chronic obstructive disease' OR 'lung disease, chronic obstructive' OR 'obstructive chronic lung disease' OR 'obstructive chronic pulmonary disease' OR 'obstructive lung disease, chronic' OR 'pulmonary disease, chronic obstructive' OR 'pulmonary disorder, chronic obstructive'

  #3. #1 AND #2

- **Web of Science**

  (ALL=(("Reality, Virtual" OR "Virtual Reality" OR "Virtual Realities" OR "Reality, Educational Virtual" OR "Realities, Instructional Virtual" OR "Reality, Instructional Virtual" OR "VR" OR “active video*” OR “interactive video” OR “virtual reality” OR “exergam*” OR “active play” OR “computer gam*” OR “video gam*” OR “gamification” OR “digital gam*” OR “rehabilitation gam*” OR “Nintendo Wii” OR “plantation” OR “Eye Toy” OR “xcox” OR “Kinect”))) AND ALL=(("Chronic Obstructive Lung Disease" OR "Chronic Obstructive Pulmonary Diseases" OR "COAD" OR "COPD" OR "Chronic Obstructive Airway Disease" OR "Chronic Obstructive Pulmonary Disease" OR "Airflow Obstruction, Chronic" OR "Airflow Obstructions, Chronic" OR "Chronic Airflow Obstructions" OR "Chronic Airflow Obstruction"))

Details of excluded articles

Excluded Studies	Title	Reason of exclusion
Xie et al. 2021	Virtual Reality Technology Combined with Comprehensive Pulmonary Rehabilitation on Patients with Stable Chronic Obstructive Pulmonary Disease	Retracted article
Zhou et al. 2021	Effects of exercise program based on somatosensory interactive games in elderly patients with stable COPD	Non-English language
Zhu et al. 2021	Clinical effect of applying somatosensory games based on Kinect 2 0 system to elderly patients with chronic obstructive pulmonary disease	Non-English language

Geng et al. 2020	Effects of applying home-based somatosensory interactive game training for fatigue and negative emotions of patients with stable COPD	Non-English language
Hu et al. 2018	Application effect of virtual reality technology in the pulmonary rehabilitation program for elderly COPD patients complicated with mild cognitive impairment	No full text availability
Liu et al. 2017	Effect of virtual reality technology combined with comprehensive pulmonary rehabilitation on stable stage COPD in the patients	No full text availability
LeGear et al. 2016	Does a Nintendo Wii exercise program provide similar exercise demands as a traditional pulmonary rehabilitation program in adults with COPD?	Low quality assessment
Makhabah et al. 2015	The role of interactive game-based system in pulmonary rehabilitation of patients with COPD	No full text availability

Additional characteristics, individual results and outcomes, and adherence to the programs

Details	VR and traditional sessions	Number of sessions	Duration	Intervention	Study	
Both groups did a traditional session at first and the intervention was performed for the relaxation session for VR group. The control group did a Schultz autogenic training sessions instead of the VR therapy sessions. The purpose of the VR therapy was basically for increasing the mood of the participants.	Hospital	10 sessions	20 minutes	Tierone device	Rutkowski 2021	1

106 patients participated in this program and were randomly assigned follows; 34 patients participated in a traditional pulmonary rehabilitation program, which included only endurance exercise training (ET), 38 patients participated in traditional pulmonary rehabilitation, including both endurance exercise training and virtual reality training (ET+VR) and other 34 patients participated in pulmonary rehabilitation program including virtual reality training but no endurance exercise training (VR).	Hospital	10 sessions	15 – 30 minutes	Xbox 360 console + Kinect motion sensor	Rutkowski 2020	2

At first both groups participated in a traditional session and then the VR group did an additional session with the Kinect system.	Not mentioned but probably hospital	Not mentioned	Not mentioned	Xbox 360 console + Kinect motion sensor	Rutkowski 2019	3
In this RCT, the intervention involving the Wii Fit video game program was an additional session for the experimental group, while the traditional program was performed for all of the patients.	Special room (in a hospital?)	18 sessions	30 minutes	Wii Fit	Sutanto 2019	4

Patients of both groups participated in a multidisciplinary program lasting 15 to 21 days, and in the last week of the pulmonary rehabilitation program, patients of the experimental group participated in 7 additional 1-hour daily sessions of Wii Fit Plus™ exercises.	Rehabilitation unit	7 sessions	60 minutes	Wii Fit Plus	Mazzoleni 2014	5

How were VR and traditional sessions performed?

study	intervention types		Duration		Program adherence (%)		Cause of program non-adherence	Summary of the results
	CG	EG	Program (week)	Frequency (per week)	CG	EG		
Mazzoleni 2014	pulmonary rehabilitation program (PRP)	interactive videogame (IV) +PRP	3 weeks	7 times per week	100%	95%	Withdrawal (EG)	The addition of IV training (IV+PRP) was more effective than PRP -Improved tolerance and dyspnea -but it had no effect on psychology or acceptance

Xie 2021	conventional rehabilitation	virtual reality + pulmonary rehabilitation	once a week	8 weeks	100%	100%		virtual reality can improve rehabilitation
Rutkowski 2019	pulmonary rehabilitation program (PRP)	Xbox 360 + pulmonary rehabilitation program (PRP)	Every day	2 weeks	100%	100%		Virtual rehabilitation is a useful method to improve mobility and fitness
Liu 2021	conventional rehabilitation	Bio Master virtual scene +	5 times	12 weeks	100%	100%		virtual reality improves lung function, cognitive function, exercise tolerance, and reduces dyspnea
Sutanto 2019	Hospital based outpatient exercise training program	hospital-based outpatient exercise training program + Wii Fit videogame program	3 times a week	6 weeks	91%	83%	Withdrawal: - Due to incomplete session times(CG) - Due to exacerbation after the second week	The video game program did not show any advantage over the standard program
Rutkowski 2021	Traditional pulmonary rehabilitation (PR) + 10 Schultz autogenic training (for relaxation)	Traditional pulmonary rehabilitation (PR) + 10 VR therapy sessions (for relaxation)	5 times a week	2 weeks	100%	100%		VR therapy is more effective than traditional Schultz autogenic training -VR Enhances Mood and Reduces Anxiety
Rutkowski 2020	The Traditional Pulmonary Rehabilitation Program + Exercise capacity training	The Traditional Pulmonary Rehabilitation Program + VR sessions	5 times a week	2 weeks	89%	89%	- Worsening of patients condition - Lost of motivation	Pulmonary rehabilitation combined with virtual reality training is beneficial for improving physical fitness.

Certainty assessment (GRADE)

Author(s): N.M., F.M., M.S.
Question: Virtual Reality compared to Standard Method for Rehabilitation in COPD patients
Setting: Randomised Trials

6 Minute Walk Test (6MWT)											
4	randomised trials	not serious	not serious	not serious	not serious	none	87	87	-	SMD **0.214 SD higher** (0.104 lower to 0.532 higher)	⨁⨁⨁⨁ High	CRITICAL
Forced expiratory volume in one second (FEV1)											
2	randomised trials	not serious	serious[a]	not serious	not serious	none	75	75	-	SMD **0.293 SD higher** (0.361 lower to 0.948 higher)	⨁⨁⨁◯ Moderate[a]	CRITICAL
St. George's Respiratory Questionnaire (SGRQ)											
2	randomised trials	not serious	not serious	serious[b]	serious[b]	none	28	28	-	SMD **173 SD lower** (0.699 lower to 0.352 higher)	⨁⨁◯◯ Low[b]	IMPORTANT
Transitional Dyspnea Index (TDI)											
2	randomised trials	not serious	very serious[c]	not serious	not serious	none	28	28	-	SMD **0.257 SD higher** (1.521 lower to 2.035 higher)	⨁⨁◯◯ Low[c]	IMPORTANT
Medical Research Council (MRC)											
2	randomised trials	not serious	not serious	not serious	serious[d]	none	28	28	-	SMD **0.281 SD lower** (0.807 lower to 0.246 higher)	⨁⨁⨁◯ Moderate[d]	IMPORTANT

CI: confidence interval; **SMD:** standardised mean difference

Explanations

a. moderate heterogeneity was detected (I^2=73%, P-value=0.05)
b. The SGRQ does not offer direct and precise answers to the questions of healthcare professionals.
c. High heterogeneity (I^2: 89%, P-value=0.003) detected between studies.
d. The MRC scale by itself could not provide clear and precise responses to the inquiries of healthcare specialists.