Supplementary materials

APPENDIX A

Based on a comprehensive review of respiratory assistive technologies, this paper proposes a multidimensional comparative evaluation framework oriented towards the integration and application of pulmonary rehabilitation robotic systems. This framework encompasses various respiratory assistive technologies, the specific paradigms corresponding to each technology, their advantages and disadvantages, the intelligent characteristics of each technology, and the potential for integrating these technologies into robotic systems, as shown in Table S1. The comparative analysis above provides guidance and reference for the selection and integration of driving modules in the outlook on pulmonary rehabilitation robotic technologies discussed in Section III. It also lays the foundation for the development directions of system intelligence (modeling, control, and evaluation) in the technological prospects of pulmonary rehabilitation robotic systems discussed in Section III.

APPENDIX B

Monitoring technology is the key foundation for the future development of pulmonary rehabilitation robot systems. Monitoring technology primarily encompasses two areas: data acquisition and data fusion based on sensor systems, and respiratory phase prediction and respiratory intent recognition based on pattern recognition technology. To enable a pulmonary rehabilitation robot system to perceive a patient's respiratory state, the major challenge is to identify an accurate and convenient sensor combination capable of capturing cross-modal heterogeneous data. During respiration, these cross-modal heterogeneous data are categorized into four distinct scales: respiratory muscle activity, thoracoabdominal wall displacement, pulmonary resistance, and respiratory airflow.

1) Monitoring of Respiratory Airflow

Monitoring the respiratory airflow usually requires tracheal intubation or the use of sensory techniques such as face masks, which are widely used because of their advantages of direct connection and proximity measurements. On the clinical side, respiratory flow meters are widely used to monitor the respiratory flow and expiratory flow rate in patients to assess their respiratory function because of the convenience, accuracy, and noninvasiveness of these devices [1]. In addition, end-expiratory CO2 monitoring is also widely used in modern critical care technology to monitor and evaluate the pulmonary ventilation and respiratory status of patients continuously and in real time by detecting the concentration of CO2 in the patient's respiratory airflow [2], [3].

2) Monitoring of Respiratory Diaphragmatic Activity

The use of ultrasound perceptual technology in the ICU has received increasing attention because of its portability, speed, safety, and encouraging results in managing multiple entities [4]–[6]. Diaphragmatic ultrasound is widely used in the clinic to monitor and evaluate patients' respiratory function because of its ability to provide real-time information on diaphragmatic morphology and function, with the main measurement being the degree of change in diaphragmatic mobility and thickness. In addition, EMGdi can be used to track and monitor diaphragmatic activity. This type of monitoring helps to quantify the patient's respiratory effort during voluntary breathing and helps to improve the rate of human–machine synchronization, but diaphragmatic electromyography measurements are susceptible to the thickness of the patient's abdominal fat [7]–[9].

3) Monitoring of Chest and Abdominal Wall Displacement

Perceptual techniques for chest and abdominal displacement are widely applied respiratory monitoring techniques. They can estimate important respiratory physiological parameters such as vital capacity and respiratory rate by detecting changes in abdominal and chest circumference [10]–[14]. Among these, RIP and FBG are the preferred options for monitoring chest wall displacement due to the inherent precision of their sensor materials [10], [12], [15], [16]. Additionally, IMUs (placed on the chest can monitor chest wall movements during patients' respiratory activities [17]. Unlike other chest strain sensor technologies, IMU sensors also record body acceleration, enabling assessment of the intensity of the subject's activity [18].

4) Monitoring of Pulmonary Resistance

Pulmonary resistance monitoring methods fall into two main categories: EIT and IP. EIT is a portable imaging technique used primarily in the operating room or ICU to provide physicians with real-time images of lung ventilation V, perfusion Q, and the V/Q ratio [19], [20]. The RR and TV of the lungs can be measured via IP. Additionally, owing to its miniaturization and low invasiveness, the IP meets the requirements for dynamic environmental measurements and portability, as supported by clinical studies [21]–[23]. As a result, IP has become the most reliable choice for monitoring lung resistance in clinical practice.

TABLE S1
RESPIRATORY ASSISTANCE PARADIGMS AND THEIR APPLICATION PROSPECTS

Type	Technology	Respiratory assistance paradigm	Strengths and Limitations	Intelligent Characteristics	Adaptable for robotic systems
MV	IMV[24]	Ventilation mode selection: Assist control ventilation (AC), Pressure support (PS), Pressure-regulated volume control (PRVC), Synchronized intermittent mandatory ventilation (SIMV).	Strengths: Provides life support for patients, protects the airway, and facilitates secretion clearance. Limitations: High risk of intubation-related complications, requires continuous sedation, and significantly increases medical costs.	Achieves personalized respiratory support through multiparameter adjustment, enabling synchronization between patient-initiated breathing and mechanical ventilation.	Due to the associated risks from its invasiveness and its lack of portability, it is not adaptable.
	NPPV (NIV)[25]	1) Ventilation mode selection: Pressure support ventilation (PSV) as the dominant mode 2) Human-machine interface selection: Based on three principles of patient-centricity, environmental adaptability, and clinical scenario. Hoods, full face masks, and oral masks are more suitable for acute respiratory failure patients; Small nasal interfaces or mouth biters are more appropriate for chronic respiratory failure patients.	Strengths: High patient acceptance, easy setup, avoiding the risks and discomfort associated with tracheal intubation. Limitations: Requires continuous airway intervention, potential skin irritation and panic disorder caused by the interface.	Leak compensation capability, patient-ventilator synchronization, and positive end-expiratory pressure (PEEP) integration capabilities.	Due to the lack of human-machine interaction, real-time feedback, and active adaptability, it is not adaptable.
	BV (NIV)	NPVs: Applying sub-atmospheric pressure to the abdomen and chest wall, increasing transpulmonary pressure to assist lung expansion, with passive expiration occurring as pressure normalizes.[26], [27]	Strengths: An early and fundamental respiratory assist technology. Limitations: Narrow patient applicability, lack of portability, and limited technical efficiency.	Low level of intelligent interaction and primitive feedback mechanisms.	Due to its lack of human-machine interaction capabilities, it is not adaptable.
		IAPVs: Periodically applying and releasing pressure to the abdomen, compressing the abdominal viscera to elevate the diaphragm for assisted expiration, and then passive inspiration through elastic retraction of the chest wall and diaphragm. [28]−[30]	Strengths: Easy to use. Limitations: Weak inspiratory assistance, unable to be used in supine position.	Open-loop control leads to lack of respiratory synchronization, with weak interactive capabilities.	Due to its lack of closed-loop feedback and human-machine interaction capabilities, it is not adaptable.
		MI-E device: First applying positive pressure (lung inflation), then rapidly applying negative pressure (lung deflation), generating high-speed airflow through a mask to assist coughing and clear secretions[31]	Strengths: Effectively assists coughing and expectoration. Limitations: Single function, with the risk of airway injury.	Adaptive control strategy regulates airway pressure to prevent airway injury.	Can be integrated into the robotic system as a single-point technical module.
		HWCFO: Inflatable vest rapidly inflates and deflates up to 20 times per second, creating chest pressure similar to manual percussion to clear mucus, typically worn for five minutes before coughing or using cough assist devices.	Strengths: Effectively assists expectoration and improves ventilation function. Limitations: Single function.	Adjustable pressure and frequency, weak human-machine interaction.	Due to its low level of intelligent interaction, it is not adaptable.
ECPR	Exo-abs [10]	1) Perception and monitoring: Multimodal sensor-based breath function monitoring for control gain modulation and respiratory synchronization feedback. 2) Respiratory assistance execution: Belt-driven pressure transmission for abdominal compression to facilitate expiration. 3) Modeling and control: Lung dynamic characteristics modeling and a control strategy analogous to variable stiffness impedance control.	Strengths: Capable of providing assistance during breathing, speaking, and coughing. System demonstrates autonomous capabilities. Limitations: Lack of specific assistance modules during the inspiratory phase.	A complete closed-loop interactive system of monitoring-assistance-modeling and control	Due to the system's complete interactive closed loop and effective functional assistance, it can be integrated as an exhalation module.
	Bionic soft exoskeleton [32], [33]	1) Perception and monitoring: A wireless monitoring device generates a reference respiratory profile and can generate control feedback to adjust robotic assist forces in real time. 2) The soft exoskeleton assists inhalation by simulating inspiratory muscle contraction through its negative pressure module, and aids exhalation by compressing the abdomen using its positive pressure module based on a soft origami actuator. 3) Modeling and control: human-robot coupled respiratory mechanics are modeled, and respiratory assistance and regulation are achieved through a model-based adaptive controller.	Strengths: Advancing soft exoskeletons from motion functionality to respiratory function, achieving full-phase extracorporeal respiratory closed-loop regulation for multiple population groups. Limitations: The human body adaptability of the negative pressure module need further improvement.	A complete closed-loop interactive system of monitoring-assistance-modeling and control	Due to the system's complete full-phase interactive closed-loop and wearable portable structure, it is adaptable.
	Rigid exoskeleton	The robot consists of two curved rubber plates, an X-shaped rod, and arm-fixing clips, which help patients vertically raise and lower their	Strengths: Specifically designed for bedridden patients. Reduces upper body weight.	No closed-loop feedback and advanced control strategy, weak	Due to its lack of intelligent human-

	[34][35]	chest under motor drive, promoting chest volume expansion and contraction, thereby alleviating breathing difficulties, enhancing respiratory muscle performance.	Addresses patient movement restrictions. Limitations: No comprehensive clinical validation conducted.	degree of intelligence	machine interaction, it is not adaptable.
	Soft Robotic Diaphragm -Assist Device [36][37]	1) Perception and monitoring: The pressure sensors monitor breathing intention and trigger the device, while also providing control feedback and evaluation. 2) The pneumatic bending actuator provides mechanical support to the diaphragm during inhalation to simulate the diaphragm's physiological movement. 3) Modeling and control: Establish physical model of the diaphragm to predict output force and implement a dual control strategy to optimize respiratory assistance.	Strengths: Innovative diaphragm assist strategy that effectively restores diaphragm function. Limitations: Lack of clinical trials and its invasiveness.	A complete closed-loop interactive system of monitoring-assistance-modeling and control	It can be integrated as an inhalation module after conducting clinical patient trials.
	Soft Wearable Respiratory Assistance robotic system [38]	1) Perception and monitoring: Respiratory intention recognition and effect evaluation based on a spirometer, along with human-machine interaction feedback based on flexible pressure sensors. 2) Pressing the patient's abdomen with a soft origami actuator to assist the exhalation process. 3) Modeling and control: Establishing a thoraco-abdominal biomechanical model and implementing a dual-layer closed-loop interactive control for force-pressure regulation.	Strengths: Achieves complete closed-loop control of human-machine interaction. Limitations: Insufficient assistance during the inhalation phase.	A complete closed-loop interactive system of monitoring-assistance-modeling and control	Due to the system's complete interactive closed loop and effective functional assistance, it can be integrated as an exhalation module.
FES	DPS	Conventional DPS: Precise stimulation through electrode implantation, progressively optimizing personalized electrical stimulation parameters to reconstruct diaphragm muscle function. [39]−[42]	Strengths: Mature and reliable for specific patient populations. Limitations: Surgical implantation risks.	Adjustable personalized electrical stimulation parameters	Due to its lack of portability and security, it is adaptable.
		EDP: The pulse generator applies electrical stimulation to the diaphragm nerve through skin electrodes according to set parameters, thus restoring diaphragm function.[43], [44]	Strengths: Safe and noninvasive, simple and portable to use. Limitations: Difficult to precisely position electrodes, significant individual therapeutic differences.	Adjustable personalized electrical stimulation parameters.	Due to its safety and portability, it is suitable as an auxiliary inspiratory module.
	FES of the intercostal muscles [45], [46]	Electrical stimulation of the upper intercostal muscles.	Limitations: Unable to provide sufficient respiratory function.	Adjustable personalized electrical stimulation parameters.	To be used in conjunction with other FES devices.
	FES of the abdominal muscles [45], [46]	Applying tiny electrical pulses to the skin above abdominal muscles, triggering muscle contractions to assist breathing. The optimal electrode placement is on the posterolateral side of the transverse abdominal muscle and internal and external muscles.	Strengths: Safe, effective, noninvasive, assists coughing. Limitations: Limited assistance with inspiration.	Adjustable personalized electrical stimulation parameters.	Can be integrated into the robotic system as a single-point technical module.
	SBM[47]	This minimally invasive technology enables wireless operation, allowing direct injection into target muscles via hypodermic needle.	Strengths: Low cost and high reliability. Limitations: Little clinical validation.	Wireless operation is possible.	Clinically validated for integration
	PNS [48], [49]	Directly pacing the phrenic nerve by placing electrodes on it, thereby generating negative intrapleural pressure to inflate the lungs.	Strengths: Low invasiveness. Limitations: Narrow range of clinical applications.	Adjustable personalized electrical stimulation parameters.	It is suitable as an auxiliary inspiratory module.
FMS	FMS[50], [51]	Using magnetic coils placed on the cervical and thoracic vertebrae, utilizing magnetic stimulation of respiratory muscles to promote negative pressure ventilation.	Strengths: Safe, noninvasive, high patient acceptance. Limitations: Large size, high cost.	Adjustable personalized magnetic stimulation parameters.	Due to its high cost and lack of portability, it is not adaptable.

Abbreviations: IMV, invasive mechanical ventilation; NPPV, noninvasive positive pressure ventilation; NIV, noninvasive ventilation; BV, body ventilator; NPV, negative pressure ventilator; IAPV, intermittent abdominal pressure ventilator; MI-E, mechanical insufflation-exsufflation; HWCFO, high-frequency chest wall oscillation vest; ECPR, exoskeleton components for pulmonary rehabilitation; DPS, diaphragm pacing system; EDP, external diaphragmatic pacemaker; FES, functional electrical stimulation; SBM, Semiconductor-Based Microstimulators; PNS, Phrenic nerve stimulation; FMS, functional magnetic stimulation.

APPENDIX C

The establishment of a respiratory mechanics model provides the theoretical foundation for the design and control of pulmonary rehabilitation robots. To further investigate how changes in thoracoabdominal pressure and diaphragm motion improve pulmonary ventilation, this section presents a detailed summary and analysis of the respiratory mechanics modeling process.

1) Respiratory mechanic modeling

The establishment of a respiratory mechanics model provides a theoretical foundation for the design and control of pulmonary rehabilitation robots. To further explore the effects of changes in thoracoabdominal cavity pressure, as well as diaphragm movement, on improving of pulmonary ventilation function, Zhang et al. [52] combined the respiratory mechanics principles proposed by Konno and Mead [53] with the concept of a two-compartment system in the context of intelligent robotics. They proposed a general human-robot coupled two-compartment respiratory mechanics model. This model can quantitatively analyze the impact of robotic assistance on respiratory function and provides key scientific evidence for clinical treatment and assessment of robotic assistance.

As shown in Fig. S1, the two-compartment model consists of the rib cage cavity and the abdominal cavity, which are separated by the diaphragm. The pleural cavity (the red part in Fig. S1) serves to connect the surface of the lungs with the rib cage cavity and the diaphragm, functioning as a small, compliant structure. The four pistons represent the rib cage, abdominal wall, diaphragm, and lung, respectively. The pistons are fixed to a stationary base, represented by a solid black wall, and they undergo displacement due to the forces applied to them.

The pressure within the pleural cavity changes with the movement of the diaphragm and ribs, and this pressure variation is transmitted to the lungs, facilitating the breathing process. During inhalation, the diaphragm moves downward, causing an increase in abdominal pressure (P_{ab}), which pushes the abdominal wall outward. During exhalation, the abdominal muscles contract, moving the abdominal wall inward, which increases P_{ab} and causes the diaphragm to move upward.

Therefore, based on these physiological characteristics, this model aims to effectively intervene in the respiratory process by using robotic technologies to intervene in abdominal wall movement, thereby causing diaphragm movement and changes in pressure within the pleural cavity. The specific modeling method is as follows:

Under the action of the inspiratory muscles, the dynamics associated with rib cage cavity expansion (P_{rc}^{mus}) can be expressed as:

$$R_{rc}\dot{V}_{rc} + \frac{V_{rc}}{C_{rc}} = P_{rc}^{mus} \quad (1)$$

where V_{rc} represents the increase in rib cage volume caused by the action of the inspiratory muscles, while R_{rc} and C_{rc} represent the resistance and compliance of the rib cage, respectively.

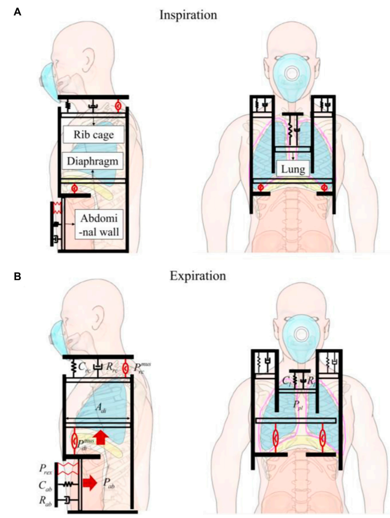

Fig. S1. The human-robot coupled two-compartment respiratory mechanic model [52]. (A) Inspiration. (B) Expiration. P_{rc}^{mus}: Rib cage muscle pressure; P_{di}^{mus}: Diaphragm muscle pressure; P_{rex}: Robotic-assisted pressure; P_{pl}: Pleural cavity pressure.

For the abdominal cavity, the force exerted by the robot's soft compression module (P_{rex}) during exhalation, together with the diaphragmatic force (P_{di}^{mus}), causes an increase in abdominal pressure:

$$P_{di}^{mus} + P_{rex} = P_{ab} \quad (2)$$

The dynamics of the abdominal cavity can be expressed as follows:

$$R_{ab}\dot{V}_{ab} + \frac{V_{ab}}{C_{ab}} = P_{ab} \quad (3)$$

where V_{ab} represents the change in abdominal volume caused by robotic actions or diaphragm activities, and where R_{ab} and C_{ab} represent the resistance and compliance of the abdomen, respectively.

The expansion and contraction of the chest cavity and the movement of the diaphragm cause changes in pressure within the pleural cavity, which can be expressed as follows:

$$\frac{V_{ab} + V_{rc}}{C_{pl}} = P_{pl} \quad (4)$$

where P_{pl} and C_{pl} represent the pressure and compliance of the pleural cavity, respectively.

The lung dynamics can be expressed as:

$$R_l\dot{V}_l + \frac{V_l}{C_l} = P_{pl} \quad (5)$$

where R_l and C_l represent the resistance and compliance of the abdomen and rib cage the of lung, respectively.

Equations (1-5) can be organized into matrix form, resulting in:

$$\begin{cases} \dot{V}_{rc} = \dfrac{1}{R_{rc}}\left(-\dfrac{1}{C_{rc}}V_{rc} + P_{rc}^{mus}\right) \\ \dot{V}_{ab} = \dfrac{1}{R_{ab}}\left(-\dfrac{1}{C_{ab}}V_{ab} + P_{di}^{mus} + P_{exo}\right) \\ \dot{V}_{l} = \dfrac{1}{R_{l}}\left(-\dfrac{1}{C_{l}}V_{l} + \dfrac{V_{ab}+V_{rc}}{C_{pl}}\right) \end{cases} \quad (6)$$

The inward movement of the abdominal wall will cause an upward displacement of an equal volume of the diaphragm, which can be calculated via equation (7):

$$x_{di} = \frac{V_{ab}}{A_{di}} \quad (7)$$

where A_{di} represents the cross-sectional area of the human body (in square meters), which can be approximated as the ratio of body weight to height.

2) Biphasic decoupling and quantification of respiration: In response to the complex interactions and coupling between the inhalation and exhalation phases, future pulmonary rehabilitation robotic systems need to achieve biphasic decoupling to increase the flexibility and effectiveness of system assistance. Zhang et al. [32] proposed a biphasic decoupling strategy during the design process of the respiratory mechanics model, which enables the independent quantification and adjustment of the dynamics of inhalation and exhalation during the robotic system's assistance process by introducing precise phase parameters. The specific quantification decoupling strategy is as follows:

The relationship between the robotic-assisted pressure and system response is as follows:

$$P_{rex} = R_l\dot{V} + \frac{V}{C_l} \quad (8)$$

During the inhalation and exhalation processes, the robot simulates natural breathing by adjusting the pressure:

$$P_{rex} = \begin{cases} P_{lung} + P_{ch} + P_{rex-ins} & \text{(Inspiration)} \\ -P_{rex-exp} & \text{(Expiration)} \end{cases} \quad (9)$$

where, P_{lung} represents the lung pressure, P_{ch} represents the chest wall pressure, and $P_{rex-ins}$ and $P_{rex-exp}$ represent the assistive pressures during the robotic inhalation and exhalation phases, respectively.

The assistive pressures of the robot in the biphasic phases can be quantified via the following time functions:

$$P_{rex}(t) = \begin{cases} P_{rex1} = K_m[1-\cos(\alpha_1 t)] & 0 < t \le t_1 \\ P_{rex2} = K_m[1+\cos(\alpha_2 t - \alpha_1 t_1)] & t_1 < t \le t_2 \\ P_{rex3} = 0 & t_2 < t \le t_3 \end{cases} \quad (10)$$

where t_1 and t_3 represent the times at which inhalation and exhalation end, respectively. t_2 is the time when the muscle pressure decreases to zero. K_m represents the maximum pressure applied by the system during the breathing process. α_1 and α_2 are parameters of the muscle pressure curve that affect the frequency and amplitude of pressure changes over time.

According to Equations (8) - (10), the decoupled biphasic dynamic respiratory response of the system can be expressed as:

$$V(t) = \begin{cases} \dfrac{K_m}{C_l} - \dfrac{K_m R_l \alpha_1 \sin(\alpha_1 t) + K_m \cos(\alpha_1 t)\, C_l}{{R_l}^2{\alpha_1}^2 + {C_l}^2} - \dfrac{K_m {R_l}^2 {\alpha_1}^2 e^{-\frac{tC_l}{R_l}}}{C_l {R_l}^2 {\alpha_1}^2 + {C_l}^3} & 0 < t \le t_1 \\ \dfrac{K_m}{C_l} + \dfrac{K_m C_l \cos(\alpha_2 t - \alpha_2 t_1)}{{R_l}^2{\alpha_2}^2 + {C_l}^2} + \dfrac{K_m R_l \sin(\alpha_2 t - \alpha_2 t_1)}{{R_l}^2{\alpha_2}^2 + {C_l}^2} & t_1 < t \le t_2 \\ \dfrac{K_m}{C_l} e^{\frac{(t_2 - t)C_l}{R_l}} - \dfrac{K_m C_l (e^{\frac{(t_1 - t)C_l}{R_l}} + e^{\frac{(t_2 - t)C_l}{R_l}})}{{R_l}^2{\alpha_2}^2 + {C_l}^2} & t_2 < t \le t_3 \end{cases} \quad (11)$$

where, K_m, α_1, α_2, t_1, t_2, and t_3 are set on the basis of existing studies [54].

APPENDIX D

The quantitative assessment of clinical pulmonary rehabilitation should include evaluations of exercise capacity, the degree of dyspnea, lung function, and health-related quality of life. These components of clinical quantitative assessment provide key evidence that pulmonary rehabilitation is effective and beneficial for patients [55]–[57]. Assessing exercise capacity is important because impairment in exercise capacity is a key characteristic of patients with COPD and other chronic respiratory diseases. Additionally, evaluating exercise capacity provides guidance for developing exercise prescriptions during the pulmonary rehabilitation process [55], [58]. Dyspnea is a common symptom among patients with chronic respiratory diseases [59]. Therefore, assessing the degree of dyspnea in patients during pulmonary rehabilitation is also essential. Lung function serves as the foundation for evaluating the functional status of the respiratory system. By assessing lung function, we can understand the extent of respiratory impairment in patients, providing an objective basis for developing personalized rehabilitation prescriptions [58]. Furthermore, respiratory diseases negatively impact patients' quality of life; thus, improving health-related quality of life is also a key benefit of pulmonary rehabilitation [55], [57]. A summary of the clinical quantitative assessment indicators for pulmonary rehabilitation is presented in Table S2.

TABLE S2
SUMMARY OF QUANTITATIVE ASSESSMENT OF RESPIRATORY REHABILITATION

Content of evaluation	Evaluation methodology	Evaluation indicators	Clinical significance	Reference
Exercise capacity	CPET	VO2 max	Assess cardiopulmonary function	[60]
	6MWT	Walking distance	Assess exercise capacity	[61], [62]
	ISWT	Maximal walking speed	Assess exercise capacity	[61], [62]
	Muscle strength test	Muscle strength	Assess muscle function and endurance	[63]
	Balance test	BBS score, 14 items	Assess balance and fall risk	[64]
	TUG, STS	Time to completion and number of trials	Assess ADL ability	[64]
Degree of dyspnea	MRC dyspnea score	Rating scale: 1-5	Assess activity tolerance and dyspnea	[65]
	CRQ	20 items, rating scale: 0-7	Assess the impact of dyspnea on quality of life	[66]
	Borg score	Rating scale: 1-10	Assess dyspnea during exercise	[58]
	BID/TID	Rating scale: 0-4	Assess the severity of dyspnea and its changes before and after intervention	[67], [68]
	UCSD SOBQ	24 items, rating scale: 0-5	Assess the severity of dyspnea and its impact on daily activities	[66]
Pulmonary function	PFSS	53 items	Assess physical, psychological, and social function	[69]
	PFSDQ/PFSDQ-M	208 items in total	Assess pulmonary function and its impact on patients' daily lives	[70]
HRQOL	SGRQ	76 items, rating each dimension	Assess the impact of respiratory diseases on quality of life	[65]

CPET, Cardiopulmonary exercise testing; 6MWT, 6-min walk test; ISWT, Incremental shuttle walk test; BBS, Berg Balance Scale; TUG, Timed Up-and-Go; STS, Sit-to-stand; ADL, Activities of Daily Living; MRC, Medical Research Council; CRQ, Chronic Respiratory Disease Questionnaire; BID, Baseline Dyspnea Index; TID, Transitional Dyspnea Index; UCSD, University of California-San Diego; SOBQ, shortness of breath questionnaire; PFSS, pulmonary functional status scale; PFSDQ, pulmonary functional status and dyspnea questionnaire; PFSDQ-M, pulmonary functional status and dyspnea questionnaire-modified version; HRQOL, health-related quality of life; SGRQ, Saint George respiratory questionnaire;

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