

## RESEARCH ARTICLE

# Knowledge, Attitudes, and Perceptions of Filipino Pediatricians on Pulmonary Rehabilitation in Children

Dianne Alexis C. Millado-Riambon<sup>1,\*</sup>, Percival A. Punzal<sup>1</sup>, Charito Carbon-De Los Santos<sup>1</sup>, Ma. Dulce R. Sy<sup>1</sup>, Bernice Ong-Dela Cruz<sup>1</sup>, Stefanni Nonna M. Paraguas<sup>1</sup>, Kelvin Mar O. Bartolome<sup>2</sup>, Martijn A. Spruit<sup>3</sup>

**\* Correspondence to:**

dialexmillado@gmail.com; ORCID: <https://orcid.org/0009-0002-8179-9143>.

**ABSTRACT**

**Background:** Pulmonary Rehabilitation (PR) is a multidisciplinary program that improves physical function, symptom control and quality of life (QoL) in patients with chronic lung diseases (CLD). Understanding pediatricians' perspectives on PR is essential to inform strategies that enhance referral practices and expand pediatric PR services.

**Objective:** the main objective is to assess the knowledge, attitudes and perceptions of Filipino pediatricians on PR among children.

**Methods:** a cross-sectional analytic study using convenience sampling was conducted through an online survey distributed to social media and Viber accounts of general pediatricians (GPs) and pediatric pulmonologists (PPs) practicing in the Philippines. The survey collected data on demographics, PR knowledge, attitudes, perceived benefits, and barriers to referral. Statistical analyses included t-tests, Mann-Whitney U tests, Chi-square/Fisher's exact tests, and univariate and multivariate logistic regression.

**Results:** a total of 102 pediatricians participated (51 GPs, 51 PPs). PPs were significantly more likely to refer patients to PR (74.5%) than GPs (23.5%) ( $p < 0.001$ ). Referral was positively associated with subspecialty training, private practice setting, geographic location, longer clinical experience, and strong belief in PR's benefits for anxiety, depression, and disease self-management. Major barriers included limited PR centers, high costs, transportation issues, and lack of awareness — factors reported by both groups.

**Conclusion:** while Filipino pediatricians acknowledge the value of PR, its utilization remains suboptimal due to systemic and perceptual barriers. Addressing gaps in knowledge, expanding access to PR services, and enhancing referral pathways are essential to optimize care for children with CLD. Strategic efforts involving training, advocacy, insurance coverage and infrastructure development are needed to promote equitable and sustained integration of pediatric PR nationwide.

**IMPACT STATEMENT**

Significant disparities in referral practices and widespread systemic barriers highlight the urgent need to strengthen pediatric PR awareness, accessibility, and integration into routine pediatric care.

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<sup>1</sup> Section of Pulmonary Rehabilitation, Division of Pulmonary & Critical Care Medicine, Philippine Heart Center East Avenue, Diliman, Quezon City, National Capital Region, Philippines

<sup>2</sup> MD Education, Training and Research Services, Philippine Heart Center; Division of Pulmonary & Critical Care Medicine, Philippine Heart Center, East Avenue, Diliman, Quezon City, Philippines

<sup>3</sup> PhD, MBA Department of Research and Development, CIRO+, Horn, the Netherlands; Department of Respiratory Medicine, Maastricht University Medical Center (MUMC+), Maastricht, the Netherlands; NUTRIM Institute of Nutrition and Translational Research in Metabolism, Faculty of Health, Medicine and Life Sciences, Maastricht University, Maastricht, Horn, Netherlands

**ABBREVIATIONS**

PR: Pulmonary Rehabilitation

QoL: Quality of Life

CLD: chronic lung diseases

GPs: general pediatricians

PPs: pediatric pulmonologists

TRC: Technical Review Committee

IERB: Institutional Ethics Review Board

ETRS-CRD: Education, Training and Research-Clinical Research Division

BPD: Bronchopulmonary Dysplasia

ILD: Interstitial Lung Diseases

CF: Cystic Fibrosis

PCD: Primary Ciliary Dyskinesia

**KEY WORDS**

*Pulmonary rehabilitation; pediatric pulmonology; chronic lung disease; referral practices; physician perceptions.*

## HIGHLIGHTS BOX

**What is already known about this topic?** Pulmonary rehabilitation (PR) benefits children with chronic lung disease, but pediatric protocols are limited, access is scarce, and referral rates remain low due to knowledge gaps, inadequate facilities, and financial and logistical barriers. **What does the article add to our knowledge?** This study identifies Filipino pediatricians' positive views of PR, highlights major referral barriers, and shows that subspecialty training, practice setting, and beliefs about psychological benefits strongly influence PR referral practices. **How does this study impact current management guidelines?** Findings support integrating PR into pediatric training, strengthening referral pathways, expanding PR access, and emphasizing its psychological benefits – informing guideline updates to improve utilization and standardize pediatric PR referral practices.

## INTRODUCTION

Pulmonary Rehabilitation is a “comprehensive intervention based on a thorough patient assessment, followed by patient-tailored therapies that includes, but is not limited to, exercise training, education, and behavior change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviors.” It is administered by healthcare professionals composing of the general physicians, pulmonologists, cardiologists, physiatrists, psychiatrists, respiratory therapists, nutritionists and others (1, 2).

Pediatric PR largely draws its framework from adult PR guidelines. However, there remains a notable lack of evidence-based protocols and standardized interventions specifically tailored for pediatric patients with pulmonary and cardiovascular diseases. The unique physiological and developmental characteristics of children — particularly their age and developmental milestones — present distinct challenges that can limit the direct application of adult PR models to younger populations. What distinguishes pediatric PR is the complexity of its implementation, especially in younger children, whereas adolescents tend to be more receptive and easier to engage. Younger patients are often motivated by play, sports, and other interactive activities, necessitating a more dynamic and age-appropriate approach to rehabilitation. Despite these challenges, pediatric PR can be a highly reward-

ing experience not only for the children but also for the healthcare professionals involved in their care (3, 4).

CLDs such as asthma, chronic bronchitis, bronchopulmonary dysplasia (BPD), interstitial lung diseases (ILD), pulmonary hypertension, cystic fibrosis (CF), and primary ciliary dyskinesia (PCD) have a profound negative impact on the lives of affected children and their loved ones. These conditions are commonly associated with dyspnea, reduced exercise tolerance, limited social interaction, and psychological distress, all of which contribute to a diminished overall QoL (5). Although there is limited published data on the efficacy of PR in the pediatric population, there is growing consensus that children with chronic respiratory conditions may derive similar benefits as their adult counterparts. Kim *et al.* (6) reported that a structured and individualized PR program led to significant improvements in exercise capacity, endurance, and psychosocial well-being among children with CLDs, ultimately enhancing their QoL. Similarly, Buschbacher *et al.* (7) highlighted the rehabilitative potential of pediatric PR, noting its role in reducing hospital admissions and emergency room visits, while also fostering family involvement in the care process. Despite these demonstrated benefits, PR remains underutilized in pediatric clinical practice. Studies by Aldhahir *et al.* (8, 9) identified the unavailability of PR programs in Saudi Arabia—attributed to a shortage of pulmonologists and trained personnel—as a significant barrier to referral and implementation. In the Philippines,

the availability of PR services for children remains markedly limited. Of the 19 identified PR centers nationwide, only one currently offers a structured PR program specifically designed for pediatric patients.

Pediatricians play a critical role in the management and referral of children to PR programs. However, their knowledge, attitudes, beliefs, and perceived barriers may significantly influence referral practices. To the best of our knowledge, this is the first study to examine the perspectives of Filipino pediatricians regarding pediatric PR, specifically exploring their beliefs, attitudes, and the barriers they encounter in clinical practice.

## RESEARCH OBJECTIVES

**a. General Objective:** to assess the knowledge, attitudes and perceptions of pediatricians on PR among children.

**b. Specific Objectives:**

- to compare the knowledge, attitudes and perception of general pediatricians and pediatric pulmonologists on PR;
- to compare the influence of demographic factors (e.g. years of experience, practice setting, geographic location) on general pediatricians and pediatric pulmonologists' attitudes and perceived barriers toward PR;
- to compare the attitudes and beliefs of general pediatricians and pediatric pulmonologists towards referring patients to PR;
- to compare barriers that prevent general pediatricians and pediatric pulmonologists from referring patients to PR programs;
- to determine the impact of general pediatricians and pediatric pulmonologists' perceptions on the utilization of PR services by pediatric patients.

## METHODS

**a. Study Design:** this is cross-sectional analytic study using an online survey through Google form.

**b. Setting and Period:** the study ran from January to November 2025. Upon the approval of the Technical Review Committee (TRC) and Institutional Ethics Review Board (IERB), data was collected through an online survey that was distributed to social media and Viber accounts and email addresses of GPs and PPs. The study was conducted and completed within a year in compliance with the Education, Training and Research-Clinical Research Division (ETRS-CRD) requirement. Participating in this study was important because it provided

valuable insights into the perspectives and practices of pediatricians in managing respiratory conditions in children. By understanding the knowledge, attitudes and perceptions that pediatricians face in implementing PR, it can potentially identify areas for improvement and can develop targeted interventions that would enhance the quality of care for pediatric patients with respiratory issues.

### c. Study Population

**i. Inclusion Criteria:** this included pediatricians who were currently practicing in Philippine hospitals and clinics (public or private), handling patients with CLD (ie. asthma, chronic bronchitis, bronchiectasis, BPD, ILD, pulmonary hypertension, CF, PCD).

**ii. Exclusion Criteria:** excluded in the study were pediatricians who did not manage patients with CLD.

**iii. Sample Size Calculation:** using G\*Power 3.1.9.7, a minimum of 68 pediatricians (34 GPs, 34 PPs) were required for this study based on an assumed 0.80 effect size between GPs and PPs in terms of their perception towards PR. This computation also accounted for a 5% level of significance and 90% power.

### d. Study Maneuver

Convenience sampling was used to recruit study participants. The questionnaire utilized in this study was adapted from a validated survey developed by Aldhahir *et al.* (9) and was posted using a secure survey platform (e.g., Google Forms) and to social media and Viber accounts. A minimum of 68 participants (34 GPs and 34 PPs) were enrolled in this study. It took approximately 15 minutes to answer the online survey. The questionnaire was divided into four sections:

**Demographic Information:** Age, gender, years of practice, specialty (general pediatrics or pediatric pulmonology), practice setting (public/private), and geographic location. **Perceptions of PR:** Questions assessed pediatricians' awareness of PR, knowledge of PR guidelines, and understanding of PR benefits in pediatric patients.

**Attitudes and Beliefs about PR:** Likert-scale questions explored attitudes toward PR's role in pediatric care, perceived benefits for children with chronic respiratory conditions, and views on the necessity of PR referrals in clinical practice. These Likert-scale responses were treated as continuous variables and scored from 1 (strongly disagree) to 5 (strongly agree). The mean scores represented overall attitudes, where a higher score indicated greater agreement.

Perceived Barriers to PR: Multiple-choice and open-ended questions assessed perceived barriers, including lack of PR facilities, cost issues, lack of knowledge, and time constraints.

#### e. Identification of Study Variables

- i. Independent Variables: Pediatric PR
- ii. Dependent Variables:
  - Attitudes toward PR (measured using Likert scales)
  - Beliefs about the effectiveness of PR in pediatric care
  - Perceived barriers to PR referrals

#### f. Statistical Analyses

Descriptive statistics were used to summarize the demographic characteristics of the pediatricians. Frequency and proportion were used for categorical variables, median and interquartile range for non-normally distributed continuous variables and mean and standard deviation for normally distributed continuous variables. The mean, rank, and frequency differences between PPs and GPs were determined using the Independent Sample T-test, Mann-Whitney U test, and Fisher's exact/Chi-square test. The Shapiro-Wilk test was used to assess the normality of continuous variables. Univariate and multivariate analysis were also used. Missing values were neither replaced nor estimated. Null hypotheses were rejected at the 0.05  $\alpha$ -level of significance. Microsoft Excel and STATA 13.1 were used for data management and analysis.

## RESULTS

**Table 1** shows the demographic profile of the participating pediatricians. Among the 102 respondents, GPs and PPs were equally represented. There were no significant differences between the groups in terms of age, sex, practice setting, or years of experience. However, a significant difference was observed in geographic distribution ( $p = 0.014$ ) with more PPs based in Metro Manila, while GPs were primarily located in Luzon outside the capital. PPs also managed more complex conditions such as BPD ( $p = 0.003$ ), pulmonary hypertension ( $p = 0.005$ ), and bronchiectasis ( $p < 0.001$ ) reflecting their subspecialty focus. Most notably, referral to PR was significantly higher among PPs (74.51%) than GPs (23.53%) ( $p < 0.001$ ), highlighting a critical disparity in referral practices that may stem from differences in exposure, training, and access.

The perceptions of PPs and GPs regarding the benefits of PR in children with CLD are in **table 2**. Both groups expressed strong agreement across all items, with mean scores generally above 4.0. For the belief that PR improved exercise capacity, the overall mean score was  $4.36 \pm 1.30$ , slightly higher among PPs ( $4.47 \pm 1.22$ ) than GPs ( $4.25 \pm 1.38$ ), though not statistically significant ( $p = 0.406$ ). Similar non-significant differences were observed in other domains, including reductions in dyspnea, anxiety, and hospital readmissions, as well as improvements in QoL and disease self-management (all  $p > 0.05$ ). These findings suggest a shared positive outlook on PR's clinical value among both pediatric subspecialties.

**Table 3** identifies the key components pediatricians believe should be included in a PR program aside from exercise. The majority of respondents recognized the importance of patient education on CLD, symptom management, psychological support, medication information, nutritional counseling, and smoking cessation. There were no significant differences between PPs and GPs in most components. However, the "Others" category, which included suggestions such as accessible center directories, follow-ups, financial assistance, and preventive measures like vaccination, was significantly more frequently cited by GPs ( $p = 0.012$ ). This may reflect GPs' broader concern for logistical and systemic support needed by patients to access PR services.

The preferred modes of delivering PR among pediatricians are shown in **table 4**. Hospital-based PR was the most preferred mode overall (58.82%), followed by home-based (30.39%) and tele-rehabilitation (10.78%). While PPs leaned more toward hospital-based delivery (64.71%) and GPs slightly favored home-based models (39.22%), these differences were not statistically significant ( $p = 0.133$ ). These preferences suggest a general inclination toward structured, supervised rehabilitation settings, but also recognition of the feasibility and practicality of alternative delivery models, especially in underserved areas.

**Table 5** examines patient-related factors that influence pediatricians' decision to refer to PR. Across both groups, factors such as breathlessness affecting mobility, decreased activity levels, low exercise tolerance, patient fatigue, and the need for education in disease management were consistently seen as strong influences to refer the patient to PR. Psychological aspects

like anxiety and depression also played a role but were less strongly emphasized. No significant differences were found between PPs and GPs for any of these factors, indicating a consensus on the clinical indicators that warrant PR referral.

The summary of perceived barriers to PR referral from the pediatricians' perspective is stated in **table 6**. The most commonly reported obstacles were limited avail-

ability of PR centers (86.27%), high treatment costs (82.35%), and transportation difficulties (68.63%). Other influential barriers included lack of information about PR, scheduling conflicts, patient refusal, comorbidities, and skepticism from patients or parents about PR's usefulness. None of the barriers showed statistically significant differences between PPs and GPs, highlighting that

**Table 1.** Demographic Profile of the Pediatricians.

	Total (n = 102)	Pediatric Pulmonologists (n = 51)	General Pediatricians (n = 51)	p-value
	Frequency (%); Median (IQR)			
<b>Age, years</b>	37 (34 to 46)	39 (35 to 46)	35 (33 to 46)	0.083
<b>Sex</b>				0.813
Male	23 (22.55)	11 (21.57)	12 (23.53)	
Female	79 (77.45)	40 (78.43)	39 (76.47)	
<b>Practice setting</b>				0.113
Private	54 (52.94)	23 (45.1)	31 (60.78)	
Government	48 (47.06)	28 (54.9)	20 (39.22)	
<b>Area of Practice</b>				0.014
Metro Manila	32 (31.68)	21 (41.18)	11 (22)	
Luzon	55 (54.46)	20 (39.22)	35 (70)	
Visayas	12 (11.88)	8 (15.69)	4 (8)	
Mindanao	2 (1.98)	2 (3.92)	0	
<b>Years of Experience in Caring for CLD Patients</b>				0.140
<1 year	9 (8.82)	5 (9.8)	4 (7.84)	
1 to 5 years	49 (48.04)	25 (49.02)	24 (47.06)	
6 to 10 years	20 (19.61)	10 (19.61)	10 (19.61)	
11 to 15 years	5 (4.9)	5 (9.8)	0	
16 to 20 years	10 (9.8)	4 (7.84)	6 (11.76)	
>21 years	9 (8.82)	2 (3.92)	7 (13.73)	
<b>What are the common chronic lung diseases in children you have encountered and managed in your practice?</b>				
Asthma	99 (97.06)	48 (94.12)	51 (100)	0.079
<b>BPD</b>	45 (44.12)	30 (58.82)	15 (29.41)	<b>0.003</b>
<b>Pulmonary hypertension</b>	44 (43.14)	29 (56.86)	15 (29.41)	<b>0.005</b>
<b>Bronchiectasis</b>	41 (40.20)	34 (66.67)	7 (13.73)	<b>&lt;0.001</b>
Cystic fibrosis	6 (5.88)	5 (9.8)	1 (1.96)	0.092
Pulmonary tuberculosis	6 (5.88)	5 (8.8)	1 (1.96)	0.092
Primary ciliary dyskinesia	3 (2.94)	2 (3.92)	1 (1.96)	0.558
Recurrent Pneumonia	1 (0.98)	1 (0.96)	0	0.315
<b>Referral to Pulmonary Rehab</b>				<b>&lt;0.001</b>
<b>Yes</b>	50 (49.02)	38 (74.51)	12 (23.53)	
No	34 (33.33)	5 (9.8)	29 (56.86)	
Not sure	18 (17.65)	8 (15.69)	10 (19.61)	

BPD: Bronchopulmonary Dysplasia. Continuous variables were analyzed using the Mann–Whitney U test, while categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate.

these challenges are widespread and systemic, affecting all pediatricians regardless of specialty.

**Table 7** outlines factors associated with PR referral based on univariate analysis. PPs were far more likely

to refer than GPs (OR = 18.37,  $p < 0.001$ ). Other significant factors associated with higher referral rates included private practice setting ( $p = 0.002$ ), Metro Manila location ( $p = 0.004$ ), experience managing bronchiectasis

**Table 2.** Pediatricians' perceptions of referring pediatric patients to PR.

	Total (n = 102)	Pediatric Pulmonologists (n = 51)	General Pediatricians (n = 51)	p-value
	Mean $\pm$ SD			
I believe that the pulmonary rehabilitation program will improve patients' exercise capacity	4.36 $\pm$ 1.30	4.47 $\pm$ 1.22	4.25 $\pm$ 1.38	0.406
I believe a pulmonary rehabilitation program would be beneficial in reducing dyspnea and fatigue	4.35 $\pm$ 1.30	4.45 $\pm$ 1.22	4.25 $\pm$ 1.38	0.450
I believe that the pulmonary rehabilitation program will improve patient anxiety and depression	4.23 $\pm$ 1.30	4.37 $\pm$ 1.22	4.10 $\pm$ 1.37	0.288
I believe that a pulmonary rehabilitation program will improve health-related quality of life	4.35 $\pm$ 1.30	4.47 $\pm$ 1.22	4.23 $\pm$ 1.37	0.364
I believe that a pulmonary rehabilitation program would help reduce hospital readmission	4.27 $\pm$ 1.30	4.37 $\pm$ 1.22	4.18 $\pm$ 1.38	0.449
I think that pulmonary rehabilitation will reduce the risk of exacerbations	4.22 $\pm$ 1.31	4.22 $\pm$ 1.25	4.23 $\pm$ 1.38	0.940
I believe that a pulmonary rehabilitation program will improve patient disease self-management	4.24 $\pm$ 1.31	4.35 $\pm$ 1.23	4.14 $\pm$ 1.38	0.408

Differences in mean perception scores were analyzed using the Independent Sample T-test.

**Table 3.** Pediatricians' perceptions regarding the important components of PR aside from exercise program.

	Total (n = 102)	Pediatric Pulmonologists (n = 51)	General Pediatricians (n = 51)	p-value
	Frequency (%)			
Information about chronic lung diseases	98 (96.08)	50 (98.04)	48 (94.12)	0.308
Symptoms management	97 (95.1)	48 (94.12)	49 (96.08)	0.647
Psychological support	93 (91.18)	48 (94.12)	45 (88.24)	0.295
Information about medications	92 (90.20)	46 (90.20)	46 (90.20)	1.000
Nutritional counselling	86 (84.31)	43 (84.31)	43 (94.31)	1.000
Smoking cessation	72 (70.59)	35 (68.63)	37 (72.55)	0.664
Others: information about accessible centers, follow ups, demonstration and return demo evaluations, preventive measures such as vaccinations, insurance coverage, financial assistance	6 (5.88)	0	6 (11.76)	0.012

Associations were analyzed using Fisher's exact test.

**Table 4.** Pediatricians' preferred mode of delivery of PR.

	Total (n = 102)	Pediatric Pulmonologists (n = 51)	General Pediatricians (n = 51)	p-value
	Frequency (%)			
Hospital-based	60 (58.82)	33 (64.71)	27 (52.94)	0.133
Home-based	31 (30.39)	11 (21.57)	20 (39.22)	
Tele-rehabilitation	11 (10.78)	7 (13.73)	4 (7.84)	

Group comparisons were analyzed using Fisher's exact test.

**Table 5.** Patient-related factors that influence the referral decision to PR.

	Total (n = 102)	Pediatric Pulmonologists (n = 51)	General Pediatricians (n = 51)	p-value
	Frequency (%)			
Mobility is affected by breathlessness.				0.571
Strong influence	88 (86.27)	45 (88.24)	43 (84.31)	
Some influence	13 (12.75)	6 (11.76)	7 (13.73)	
No influence	1 (0.98)	0	1 (1.96)	
Decreasing activity levels				0.567
Strong influence	90 (88.24)	46 (90.20)	44 (86.27)	
Some influence	11 (10.78)	5 (9.8)	6 (11.76)	
No influence	1 (0.98)	0	1 (1.96)	
Low exercise tolerance				0.578
Strong influence	80 (78.43)	41 (80.39)	39 (76.47)	
Some influence	21 (20.59)	10 (19.61)	11 (21.57)	
No influence	1 (0.98)	0	1 (1.96)	
Patient anxiety related to the disease				0.350
Strong influence	60 (58.82)	30 (58.82)	30 (58.82)	
Some influence	40 (39.22)	21 (41.18)	19 (37.25)	
No influence	2 (1.96)	0	2 (3.92)	
Patient depression related to the disease				0.528
Strong influence	58 (56.86)	28 (54.9)	30 (38.82)	
Some influence	43 (42.16)	23 (45.1)	20 (39.22)	
No influence	1 (0.98)	0	1 (1.96)	
Patient education and disease management				0.972
Strong influence	77 (75.49)	38 (74.51)	39 (76.47)	
Some influence	23 (22.55)	12 (23.53)	11 (21.57)	
No influence	2 (1.96)	1 (1.96)	1 (1.96)	
Patient fatigue related to the disease				0.508
Strong influence	85 (83.33)	44 (86.27)	41 (80.39)	
Some influence	16 (15.69)	7 (13.73)	9 (17.65)	
No influence	1 (0.98)	0	1 (1.96)	
Dietary advice				0.427
Strong influence	40 (39.22)	18 (35.29)	22 (43.14)	
Some influence	55 (53.92)	28 (54.9)	27 (52.94)	
No influence	7 (6.86)	5 (9.8)	2 (3.92)	

Associations were analyzed using Fisher's exact test.

( $p = 0.034$ ), and longer clinical experience ( $p = 0.005$ ). Belief in the psychological benefits of PR, particularly its effects on anxiety, depression, self-management, and reducing hospital readmissions also significantly increased the likelihood of referral ( $p < 0.01$  for each).

**Table 8** shows the multivariate analysis of factors independently associated with PR referral. Even after adjusting for other variables, being a PP (aOR = 450.01,  $p = 0.001$ ), working in a private setting (aOR = 10.64,  $p = 0.007$ ), and believing that PR improves anxiety and depression

**Table 6.** Barriers to referring pediatric patients to PR from pediatrician's perspective.

	Total (n = 102)	Pediatric Pulmonologists (n = 51)	General Pediatricians (n = 51)	p-value
	Frequency (%)			
Don't have enough information about the pulmonary rehabilitation program				0.313
Strong influence	62 (60.78)	30 (58.82)	32 (62.75)	
Some influence	27 (26.47)	12 (23.53)	15 (29.41)	
No influence	13 (12.75)	9 (17.65)	4 (7.84)	
Uncertain that the program is worthwhile				0.581
Strong influence	41 (40.20)	22 (43.14)	19 (37.25)	
Some influence	35 (34.31)	15 (29.41)	20 (39.22)	
No influence	26 (25.49)	14 (27.45)	12 (23.53)	
Patient refuses referral				0.182
Strong influence	58 (56.86)	25 (49.02)	33 (64.71)	
Some influence	41 (40.20)	25 (49.02)	16 (31.37)	
No influence	3 (2.94)	1 (1.96)	2 (3.92)	
Patient comorbidities				0.478
Strong influence	40 (39.22)	20 (39.22)	20 (39.22)	
Some influence	48 (47.06)	26 (50.98)	22 (43.14)	
No influence	14 (13.73)	5 (9.8)	9 (17.65)	
The patient has doubts that rehabilitation is worthwhile				0.500
Strong influence	43 (42.16)	22 (43.14)	21 (41.18)	
Some influence	52 (50.98)	27 (52.94)	25 (49.02)	
No influence	7 (6.86)	2 (3.92)	5 (9.8)	
Transportation problems				0.387
Strong influence	70 (68.63)	38 (74.51)	32 (62.75)	
Some influence	26 (25.49)	10 (19.61)	16 (31.37)	
No influence	6 (5.88)	3 (5.88)	3 (5.88)	
The timing of scheduled pulmonary rehabilitation sessions is not convenient for the patient				0.898
Strong influence	67 (65.69)	34 (66.67)	33 (64.71)	
Some influence	31 (29.41)	15 (29.41)	15 (29.41)	
No influence	5 (4.9)	2 (3.92)	3 (5.88)	
Treatment cost				0.850
Strong influence	84 (82.35)	43 (84.31)	41 (80.39)	
Some influence	13 (12.75)	6 (11.76)	7 (13.73)	
No influence	5 (4.9)	2 (3.92)	3 (5.88)	
Availability of pulmonary rehabilitation centers				0.469
Strong influence	88 (86.27)	46 (90.2)	42 (82.35)	
Some influence	12 (11.76)	4 (7.84)	8 (15.69)	
No influence	2 (1.96)	1 (1.96)	1 (1.96)	

Associations were analyzed using Chi-square test or Fisher's exact test, as appropriate.

(aOR = 8.90, p = 0.001) remained statistically significant predictors of referral. These findings reinforce the importance of specialty training, practice context, and clinician beliefs in shaping referral behavior for pediatric PR.

**DISCUSSION**

The demographic findings of this study reveal structural differences between PPs and GPs. PPs were more likely to practice in Metro Manila, while GPs were predomi-

**Table 7.** Factors Associated with the Referral to Pediatric Pulmonary Rehabilitation (univariate analysis).

Parameters	Crude odds ratio	95% CI	p-value
<b>Group</b>			
General Pediatricians	(reference)	-	-
<b>Pediatric Pulmonologists</b>	18.367	5.8169 to 57.992	<b>&lt;0.001</b>
<b>Age</b>	0.9484	0.9040 to 0.9949	<b>0.030</b>
<b>Practice setting</b>			
Private	(reference)	-	-
<b>Government</b>	4.5322	1.7490 to 11.744	<b>0.002</b>
<b>Area/Place of practice</b>			
Metro Manila	(reference)	-	-
<b>Luzon</b>	0.1637	0.0484 to 0.5545	<b>0.004</b>
Visayas	0.6316	0.1161 to 3.4368	0.595
Mindanao	-	-	-
<b>Bronchiectasis</b>	2.7778	1.0826 to 7.1269	<b>0.034</b>
<b>Years of experience</b>			
≤5 years	(reference)	-	-
6 to 15 years	0.6364	0.2137 to 1.8953	0.417
<b>&gt;15 years</b>	0.1768	0.0524 to 0.5965	<b>0.005</b>
I believe that the pulmonary rehabilitation program will improve patient anxiety and depression	3.2065	1.5907 to 6.4637	<b>0.001</b>
I believe that a pulmonary rehabilitation program would help reduce hospital readmissions	2.7483	1.4622 to 5.1656	<b>0.002</b>
I think that pulmonary rehabilitation will reduce the risk of exacerbations	2.0485	1.3292 to 3.1571	<b>0.001</b>
I believe that a pulmonary rehabilitation program will improve patient disease self-management	2.9716	1.5536 to 5.6840	<b>0.001</b>

Factors associated with referral to PR based on univariate analysis using simple logistic regression.

**Table 8.** Factors Associated with the Referral to Pediatric Pulmonary Rehabilitation (multivariate analysis).

Parameters	Adjusted odds ratio	95% CI	p-value
<b>Group</b>			
General Pediatricians	(reference)	-	-
<b>Pediatric Pulmonologists</b>	450.01	11.021 to 18375	<b>0.001</b>
<b>Practice setting</b>			
Private	(reference)	-	-
<b>Government</b>	10.640	1.9325 to 58.584	<b>0.007</b>
I believe that the pulmonary rehabilitation program will improve patient anxiety and depression	8.8967	2.4871 to 31.825	<b>0.001</b>

Factors independently associated with referral to pulmonary PR based on multivariate analysis using multiple logistic regression.

nantly based in other areas of Luzon ( $p = 0.014$ ), and PPs more frequently managed complex respiratory conditions such as BPD ( $p = 0.003$ ), pulmonary hypertension ( $p = 0.005$ ), and bronchiectasis ( $p < 0.001$ ). Nationally, there are approximately 6,581 GPs (10) and only 271 PPs (11), with a large concentration in the National Capital Region. This imbalance provides important context for the observed differences in PR referral practices and access to specialized care.

A key finding of this study was the significantly higher referral rate to PR among PPs (74.51%) compared to GPs (23.53%) ( $p < 0.001$ ). This supports prior findings from Aldhahir *et al.* (8, 9), who noted that specialists with advanced training in pulmonology are more likely to refer patients to PR. This may be due to increased familiarity with PR principles, a stronger understanding of its benefits, and greater involvement in structured PR programs. Conversely, studies conducted by Kunoor *et al.* (12) in India and Hao *et al.* (13) in China demonstrated lower referral rates among respiratory physicians in selected regions, largely attributable to the limited availability of PR facilities despite adequate knowledge of and awareness regarding the benefits of PR.

While children in urban regions such as Metro Manila may benefit from better access to PR services, the disparity in specialist distribution underscores the need for policy-level initiatives to ensure equitable access to both general and specialized pulmonary care across the country.

Both GPs and PPs in this study exhibited positive attitudes toward PR, recognizing its potential to enhance exercise tolerance, reduce symptoms such as dyspnea and fatigue, and improve psychosocial well-being. This observation is in concordance with the findings of Aldhahir *et al.* (8, 9) and Sahasrabudhe *et al.* (14), which reported a generally favorable inclination among clinicians to refer patients with CLD—particularly those experiencing reduced exercise capacity, shortness of breath, easy fatigability and compromised airway clearance—to PR programs. These views reflect the broader consensus in the literature about PR's multifaceted benefits in pediatric populations.

Beyond exercise training, pediatricians emphasized the importance of additional PR components such as disease education. Education is one of the key compo-

nents of PR and health care providers recognize it as essential as exercise training. Disease-specific education plays a critical role in enhancing patients' ability to recognize symptoms and identify disease exacerbations thus allowing them to self-manage their symptoms successfully. Pediatricians further underscored the relevance of nutritional counseling, psychological support and smoking cessation as other integral components of PR. Notably, GPs were more likely to highlight the essential contributions of auxiliary elements such as insurance coverage, follow-up services, and accessibility of PR centers ( $p = 0.012$ ). Consistent findings across multiple studies (8, 9, 15) demonstrate that health-care professionals identify education, smoking cessation, nutritional counseling, and symptom management as integral components of PR. In addition, these studies highlight the pivotal role of insurance coverage and the accessibility of PR centers. Taken together, these observations reinforce the need for comprehensive PR programs that systematically integrate educational and psychosocial elements to optimize patient adherence and long-term outcomes, while underscoring the importance of improving the availability and accessibility of rehabilitation services.

Hospital-based PR was the most preferred mode of delivery (58.82%), followed by home-based and telerehabilitation. Similarly, evidence from three studies demonstrates a general preference for hospital-based PR over home-based or telerehabilitation modalities (9, 16, 17). This preference mirrors global trends where hospital-based programs are favored due to structured supervision where patients are monitored closely during exercise, thus enhancing safety and allowing for immediate intervention needed, access to multidisciplinary teams which ensure more holistic care, and immediate clinical support. Nonetheless, evidence also supports the efficacy of home-based and telerehabilitation modalities. A study conducted in the Philippines demonstrated that, in response to the COVID-19 pandemic, PR services transitioned from conventional face-to-face delivery to telerehabilitation, with post-acute COVID-19 adults patients showing improvements in exercise capacity (18). Home-based and telerehabilitation therefore can be modalities, particularly in improving access for families in remote areas and those facing financial or logistical barriers (19-22).

Patient-related clinical indicators such as breathlessness, reduced activity, fatigue, and low exercise tolerance were consistently cited as strong referral drivers by both PPs and GPs. These align with global referral patterns that prioritize functional limitations and symptom burden as key considerations for PR enrollment (8, 9).

Despite generally positive perceptions, our study identified barriers such as lack of adequate information about PR, patient refusal, comorbid conditions, skepticism regarding PR's value, transportation challenges, inconvenient scheduling, financial constraints and limited availability of PR centers. Of all these, transportation and costs were major concerns and the limited number of PR centers was identified as a key barrier. In the Philippine context, PR utilization is influenced by a combination of cultural, health system, and economic factors that collectively constrain access and uptake. Cultural perceptions of CLD such as underestimating the disease severity due to stoicism, reliance on informal care, traditional and folk medicines and faith-based healing may contribute to delayed health-seeking behavior and reduced prioritization of structured rehabilitation interventions (23). Within the healthcare system, PR remains insufficiently integrated into standard respiratory care pathways, with limited availability of PR services and referral mechanisms, particularly outside urban centers. Importantly, PR is not covered by national health insurance schemes, including the Philippine Health Insurance Corporation (PhilHealth), necessitating full out-of-pocket payment by patients. This represents a substantial barrier in a setting where the average annual income of Filipino families is approximately ₱350,000, or about ₱29,000 per month (24). Consequently, the cost of PR enrollment — estimated at ₱24,000 for a 24-session program — constitutes a considerable financial burden, approaching one month of average household income. These systemic and economic constraints likely contribute to the low utilization of PR services in the Philippines, particularly among low- and middle-income families.

Moreover, the limited number of PR centers in the Philippines with only 19 centers nationwide — most of which cater exclusively to adult patients and only a single center offering PR programs for both adult and

pediatric patients — exacerbates existing access disparities. This challenge is compounded by the scarcity of trained personnel and the lack of standardized pediatric PR protocols. Results from studies conducted in upper-middle-income countries including China (13, 25) and Malaysia (26); and low-to-middle-income countries such as India (12, 14) and Kyrgyzstan (27) indicate the same barriers to PR that also largely stem from constrained healthcare resources, limited awareness, and patient-related access and cost burdens. Notably, such limitations are not unique to low-to-middle income resource settings. Even in high-income countries such as Saudi Arabia (8, 9), the United States (28), France (29), Australia (30), and Canada (31), the distribution of PR centers remains inadequate, especially in rural and underserved areas. Collectively, these findings underscore the urgent need to expand PR infrastructure and integrate PR more effectively into national health systems through coordinated efforts among governing bodies and professional organizations.

Additional barriers such as comorbidities, patient or caregiver skepticism, and insufficient physician knowledge about PR were also identified. These factors may delay or prevent referrals, especially among GPs, who may have less exposure to PR in training or practice. Lack of robust pediatric-specific PR data further contributes to these knowledge gaps and reduces confidence in the intervention's efficacy for children.

The multivariate analysis revealed that three key predictors significantly influenced referral behavior: being a PP (aOR: 450.01), practicing in the private sector (aOR: 10.64), and the belief that PR improves anxiety and depression (aOR: 8.90). This last factor is particularly notable, given the rising burden of mental health issues among children with chronic illnesses. PR's holistic approach, which integrates physical rehabilitation with psychosocial support, is well-suited to address this dual burden.

Despite increasing awareness, global PR referral rates remain suboptimal (32), especially in pediatrics. Pediatricians are gatekeepers to PR access, and without their referral, children are unlikely to benefit from these programs. This underscores the need for continuing professional development, including workshops and online training, to enhance pediatricians' understanding of PR.

Furthermore, expanding the use of digital platforms and social media to educate families may foster greater acceptance and adherence to PR.

Lastly, the study's findings highlight structural and systemic challenges that require policy-level interventions. Strengthening referral systems, increasing funding for PR programs, and establishing new centers—particularly in underserved areas—are critical steps toward achieving equitable access.

There are several limitations of the study. The use of convenience sampling and online survey distribution introduces potential selection and response bias. Recruitment through social media platforms, messaging applications, and email networks may have captured pediatricians who are more digitally engaged, affiliated with academic or tertiary centers, or have greater interest or exposure to PR. These sampling methods may have influenced reported attitudes and referral practices. Pediatricians with favorable perceptions of PR or prior experience with PR programs may have been more inclined to participate. In contrast, pediatricians with limited access to PR facilities, lower awareness of PR, or greater practice constraints — particularly those in rural or resource-limited settings — may be underrepresented. Finally, these factors limit the generalizability of the findings. While the study provides important insights into the perspectives of pediatricians accessible through online networks, the results may not fully reflect the views and practices of all Filipino pediatricians nationwide.

Future research should employ probability-based or stratified sampling methods to improve representativeness and reduce selection bias. Targeted recruitment of pediatricians from geographically underserved regions, public sectors, and rural practice settings is particularly important to ensure that perspectives from areas with limited PR access are adequately captured. Expanding sample sizes and including multiple recruitment modalities — such as institutional registries, professional society databases, and on-site data collection — may further enhance external validity and generalizability. Further, prospective studies evaluating changes in knowledge, attitudes, and referral practices following targeted educational interventions are needed to establish causal relationships and inform effective implementation strategies.

## CONCLUSION

This study highlights the generally positive perceptions of Filipino pediatricians regarding PR for children with CLD but also underscores a significant gap between recognition of PR's benefits and actual referral practices—particularly among GPs. PPs demonstrated higher referral rates, likely due to their specialized training and greater clinical exposure to complex respiratory conditions.

Key factors associated with the increased likelihood of referral included subspecialty training, private practice setting, geographic location, and strong beliefs in PR's psychological and physical benefits. Conversely, major barriers to referral were limited availability of PR centers, high out-of-pocket costs, transportation difficulties, and insufficient awareness or understanding of PR programs—challenges that disproportionately affect patients in underserved and rural areas.

By addressing these gaps, healthcare providers can optimize the delivery of multidisciplinary care and improve long-term outcomes for pediatric patients with CLD. First, the integration of PR principles into pediatric residency and subspecialty training curricula is essential to strengthen early exposure, improve knowledge, and normalize PR referral as a standard component of chronic respiratory care. Second, the expansion of telerehabilitation and hybrid PR pilot programs should be prioritized to address geographic inequities, transportation barriers, and workforce limitations, particularly in underserved and rural areas. Third, the development of clear, standardized national referral pathways — linking GPs, PPs, and rehabilitation teams — may streamline referrals and reduce variability in practice. Lastly, sustained policy engagement is critical; government stakeholders must formally include PR within national health priorities by strengthening insurance reimbursement mechanisms and expanding health coverage to encompass PR services. Collectively, these measures may enhance access, improve referral practices, and support the long-term integration of pediatric PR into the Philippine healthcare system.

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## COMPLIANCE WITH ETHICAL STANDARDS

### Conflicts of interests

Dr. Bernice Ong-Dela Cruz received honoraria for lectures conducted for Astra Zeneca, Phil United American Philippines (UAP), Orient Euro Pharma (OEP) and Glaxo-Smith-Kline (GSK). Her other remunerations included clinical trials conducted for GSK Healthcare Phil, Astra Zeneca.

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There are no other identified conflicts of interest between the other investigators, the participants, or the Philippine Heart Center.

### Fundings

The authors declare that no financial support or funding sources were granted in the making of the study design, data collection and interpretation and the decision to submit the manuscript for publication.

### Author contributions

Conceptualization: DR, PP, CD, MS, BD, SP, KB, MS. Data Curation: DR, CD, MS. Formal Analysis: DR, PP, CD, MS, BD, SP, KB, MS. Investigation: DR, PP, CD, MS, BD, SP, KB, MS. Methodology: DR, PP, CD, MS, BD, SP, KB, MS. Project Administration: DR, PP, CD. Resources: DR, CD, MS. Software: DR, KB. Supervision: DR, PP. Validation: DR, PP, CD, MS, BD, SP, KB, MS. Visualization: DR. Writing – original draft: DR, PP, CD, MS, BD, SP, KB, MS. Writing – review and editing: DR, PP, CD, MS, BD, SP, KB, MS.

### Ethical approval

#### Human studies and subjects

This study was conducted in accordance with the Declaration of Helsinki and the National Ethical Guidelines for Health and Health-Related Research (NEGHR 2017). The study protocol, informed consent, and subsequent amendments were reviewed and approved by the Philippine Heart Center IERB (PHC.IERB.01.25.09; EP.OR.005.24) and adhered to the Data Privacy Act of 2012 of the Philippines.

Informed consent was obtained electronically through an online link containing the consent form and survey. Participants indicated consent by selecting “Yes, I will join the study” and were directed to the online survey. Those who selected “No” exited without completing the questionnaire.

#### Data sharing and data accessibility

Data are available upon motivated request to the Corresponding Author.

#### Publication ethics

##### Plagiarism

Authors declare no potentially overlapping publications with the content of this manuscript and all original studies are cited as appropriate.

##### Data falsification and fabrication

All the authors of the manuscript hereby declare that the submitted manuscript represents original and unpublished material. Furthermore, the authors also declare that there are no potentially overlapping publications on submission. No parts of the manuscript has been written and produced with the aid of artificial intelligence.

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**APPENDICES****GOOGLE FORM****QUESTIONNAIRE****I. Demographic Information**

Participant code number: \_\_\_\_\_

Are you a practicing:  General Pediatrician who handles chronic respiratory diseases Pediatric Pulmonologist

Age: \_\_\_\_\_

Gender: \_\_\_\_\_

Practice Setting: Private \_\_\_\_\_ Government \_\_\_\_\_

Area of Practice: \_\_\_\_\_

What are the common chronic lung diseases in children that you have encountered and managed in your practice?

 Asthma Bronchiectasis Bronchopulmonary dysplasia Pulmonary hypertension Cystic fibrosis Primary ciliary dyskinesia Others: \_\_\_\_\_

How many years of experience do you have in caring for pediatric patients with chronic lung diseases?

 <1 year 1-5 years 6-10 years 11-15 years 16-20 years >21 years

Will you refer a pediatric patient with chronic respiratory disease to pulmonary rehabilitation?

 Yes No Not sure**II. Perceptions of Pulmonary Rehabilitation Program**

1. For each statement, please select the answer that best suits your opinion.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I believe that pulmonary rehabilitation program will improve patient's exercise capacity.					
I believe that pulmonary rehabilitation program would be beneficial in reducing dyspnea and fatigue.					
I believe that pulmonary rehabilitation program will improve patient anxiety and depression.					
I believe that pulmonary rehabilitation program will improve health-related quality of life.					

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I believe that pulmonary rehabilitation program would help in reducing hospital readmission.					
I think that pulmonary rehabilitation will reduce the risk of exacerbations.					
I believe that pulmonary rehabilitation program will improve patient nutritional status.					
I believe that pulmonary rehabilitation program will improve patient disease self-management.					

**III. Referral to Rehabilitation Program**

1. In your opinion, what factors might influence decision to refer pediatric patients with chronic lung diseases to a pulmonary rehabilitation program?

	No influence	Some influence	Strong influence
Mobility, affected by breathlessness			
Decreased activity levels			
Low exercise tolerance			
Patient anxiety related to disease			
Depression related to disease			
Patient education and disease management			
Fatigue related to disease			
Dietary advice			
Others please give details			

2. In your opinion, what factors might influence decision on NOT to refer to pediatrics patients to a pulmonary rehabilitation program?

	No influence	Some influence	Strong influence
I don't have enough information about pulmonary rehabilitation program			
I'm uncertain that the program is worthwhile			
I am uncertain to refer to pulmonary rehabilitation program because of my patient's co-morbidities			
My patient has doubts that pulmonary rehabilitation is worthwhile			
My patient has transportation problems			
Timing of scheduled pulmonary rehabilitation sessions not convenient for my patient			
Treatment cost			
Availability of pulmonary rehabilitation centers			
Others please give details			