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Knowledge, Attitudes, and Perceived Facilitators and Barriers to Patient and Public Involvement and Engagement in Health-relate Research: A Cross-Regional Survey of Healthcare Professionals and Researchers in the Greater Bay Area of China

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Abstract

Background

Patient and public involvement and engagement (PPIE) is increasingly recognised as essential for improving the relevance, quality, and impact of health-related research. However, evidence on the adoption and implementation of PPIE in China, particularly in the Greater Bay Area (GBA), remains limited. This study aimed to examine the knowledge, experience, attitudes, and perceived facilitators and barriers regarding PPIE among healthcare professionals (HCPs) and researchers in the GBA of China.

Methods

A cross-sectional online survey was conducted between December 2024 and April 2025 across six health and academic institutions in Guangdong Province, Hong Kong, and Macao. A structured questionnaire was developed based on a literature review, expert consultation, and the Context and Implementation of Complex Interventions (CICI) framework. Descriptive statistics and the Cochran–Mantel–Haenszel (CMH) chi-square test were used to examine regional differences, with adjustment for age group, educational level, and period of clinical experience.

Results

A total of 396 HCPs and researchers completed the survey. Most participants (68.7%) had no prior PPIE experience. Understanding of PPIE was limited, particularly in 55.2% Guangdong Province reported "little understanding" to the adoption and implementation of PPIE. Despite this, 97.5% recognized the importance of PPIE and expressed interest in training. Key perceived facilitators included improved participant recruitment (66.9%), enhanced trust (62.6%), and improved healthcare quality (61.6%). Major barriers were uncertainty about implementation (79.5%), patients' limited health literacy (63.9%), and insufficient resources (63.6%). Significant regional differences were observed in knowledge, confidence, willingness to engage, and perceptions of facilitators and barriers.

Conclusions

This first cross-regional survey in the GBA of China shows that HCPs and researchers generally hold positive attitudes towards PPIE but face substantial knowledge gaps, limited practical experience, and institutional and resource constraints. Regionally tailored training, enhanced institutional support, and clear operational and ethical guidelines are needed to translate positive attitudes into sustainable PPIE practice.

1 INTRODUCTION

Patient and public involvement and engagement (PPIE) has become a cornerstone of high-quality health-related research, particularly within Western contexts [1]. The NIHR initially defines PPIE as research conducted "with" or "by" members of the public, rather than "to," "about," or "for" them [2]. Drawing upon the widely recognized NIHR framework, the conceptual analysis of PPIE by Lu et al. (2026) emphasizes a collaborative model of PPIE to enhance conceptual clarity and methodological consistency, which involves active and respectful cooperation among patients, caregivers, community members, HCPs, and researchers [3]. The "involvement and engagement" of PPIE refers to two-way interaction, including sharing research results, improving public access to research findings, and raising public awareness through clear communication and targeted promotional activities. This collaborative paradigm marks a fundamental shift from traditional researcher-led models, in which patients and the public often participated merely as research subjects, to a framework that recognises them as equal partners in the research process [3, 4]. The benefits of PPIE are well-documented and include enhanced research relevance, improved participant recruitment and retention, increased public trust, and more impactful health outcomes [5, 6]. Thus, major funding bodies and research institutions in countries such as the United Kingdom, the United States, Canada, and Australia have increasingly mandated or incentivised the integration of PPIE into health-related research [7, 8] .

Despite these recognised advantages and growing global momentum, the adoption and implementation of PPIE remain nascent in many Asian healthcare systems, including China [3]. A recent systematic review noted a significant increase in PPIE-related publications from Asian countries between 2021 and 2024, yet the overall volume remains sparse relative to Western output, and the conceptualisation and practice of PPIE are often inconsistent [3]. In China, several contextual factors may hinder the effective adoption of PPIE. Prevailing socio-cultural norms, including traditional paternalistic models of care, often position patients in a passive role, which may conflict with the collaborative ethos of PPIE [9]. Moreover, the absence of explicit policy mandates or dedicated funding streams for PPIE in Chinese health research further

limits its systematic integration [10]. These challenges are compounded by definitional ambiguities, as PPIE is frequently conflated with related but distinct concepts such as patient-centred care or shared decision-making, leading to inconsistent application and evaluation [11].

The Greater Bay Area (GBA) of China, comprising Guangdong Province, Hong Kong, and Macao, presents a uniquely strategic and complex context for investigating the adoption and implementation of PPIE. This region is characterised by significant economic integration, a large and diverse population, and a high concentration of medical research institutions and national laboratories [12]. Over 3.4% of regional resources are allocated to health-related research, providing a robust foundation for innovation [13]. However, the GBA also encompasses three distinct healthcare systems with differing policies, regulations, and ethical frameworks [14]. The linguistic diversity within the various regions of the GBA of China, such as Cantonese, Mandarin, and English, and substantial population mobility, with large numbers of domestic migrants and cross-border residents, adding further layers of complexity [15, 16]. These characteristics may simultaneously facilitate inclusive and culturally nuanced PPIE practices while also posing significant logistical and resource-related barriers [17]. Understanding how these systemic and cultural factors shape stakeholder perspectives is essential for developing contextually appropriate PPIE strategies.

Although the importance of PPIE in health-related research is widely acknowledged, there is limited understanding of its adoption and implementation within China's distinct socio-cultural and systemic context. As primary initiators and facilitators of PPIE, HCPs and researchers play a pivotal role in translating PPIE principles into practice [18]. Current literature primarily addresses the perspectives and challenges experienced by patients and the public in PPIE research, whereas the views and attitudes of HCPs and researchers remain unexplored [9]. In particular, research is lacking on the perceived facilitators, barriers, and practical challenges that HCPs and researchers face when adopting and implementing PPIE in health-related research in the GBA of China. Addressing this knowledge gap is crucial for developing culturally and systemically informed strategies to effectively guide and promote PPIE in China, as well as to provide comparative insights for global practice. These gaps are addressed in the present study through the Context and Implementation of Complex Interventions (CICI) framework [19], which conceptualises PPIE adoption as a complex process shaped by interacting contextual, implementation, and setting dimensions. It includes geography, social culture, ethics, law and politics, respectively corresponding to the medical systems, institutions and multilingual environment of Guangdong Province, Hong Kong and Macao. This framework thus enables a systematic, theory-informed comparison of how systemic and cultural factors shape PPIE across Guangdong Province, Hong Kong, and Macao. Thus, the aims of this study are to explore knowledge, experience, and attitudes regarding PPIE among HCPs and researchers in the GBA of China and identify the facilitators and barriers to the adoption and implementation of PPIE in health-related research.

2 METHODS

Study design and setting

This was a cross-sectional study conducted through an online questionnaire. The survey was voluntary and completed anonymously. The completed GRIPP2 reporting checklist is given in Additional File 1.

A research team was established to execute specific research tasks. The research team was informed of the ongoing steps of the research and participated in the discussion of the findings. This survey included HCPs and researchers affiliated with health institutions and universities in the GBA of China, comprising Guangdong Province (Sun Yat-sen Memorial Hospital, The Second People's Hospital of Foshan), Hong Kong (The Hong Kong Polytechnic University, The Chinese University of Hong Kong), and Macao (Macao Polytechnic University Nursing Academy, Kiang Wu Nursing College of Macao). The study lasted 7 months, from December 2024 to April 2025.

Ethics statement

This study received ethical approval from the Institutional Review Board of The Hong Kong Polytechnic University (Application Number: HSEARS20240829001-01). All participants provided informed electronic consent prior to commencing the survey.

The development process and validation process of the online Questionnaire

The online questionnaire was developed and validated through a three-stage process, guided by the CICI framework [19]. In Stage 1, item generation was informed by a systematic literature review across five databases (PubMed, Web of Science, CINAHL, Cochrane Library, and ProQuest) and structured around the context, implementation, and setting dimensions of the CICI framework to operationalise key constructs related to HCPs' and researchers' knowledge, attitudes, and experiences regarding the adoption and implementation of PPIE. 14 eligible articles were selected to inform the initial questionnaire (Additional file 2) and it comprised four dimensions: basic information, understanding and experience of PPIE, perceived facilitators and barriers, and future development, with item wording following established recommendations for clarity and conciseness.

In Stage 2, content validity was assessed by a panel of six experts, who rated each item on importance, relevance, and clarity using a 4-point Likert scale. The Content Validity Index (CVI) for the three criteria were 0.850, 0.895, and 0.947, respectively, indicating satisfactory validity and strong expert consensus.

In Stage 3, minor revisions were made to item definitions based on expert feedback, The questionnaire had 4 dimensions and 34 items. The final questionnaire (Additional file 3) was pilot-tested by the research team using the “Questionnaire Star” platform to ensure functionality and data management efficiency, and then distributed for formal data collection.

Participants and recruitment

Participants were recruited using a convenience sampling method. The research team established collaborations with six partner organizations, which facilitated the distribution of an online survey (via QR code) to their staff. All participants provided informed electronic consent before being directed to the survey. We aimed for a maximum variation sample [20], seeking diversity across numerous areas, such as workplace (healthcare institutions or universities), region, level of seniority, age and gender. The "Questionnaire Star" platform was used for survey administration, data collection, and management, which was a secure web-based software platform designed to support data capture for research studies, and hosted at The Second People's Hospital of Foshan.

Participants were eligible if they met the following inclusion criteria: (1) aged 18 years or older; (2) currently employed in nursing, medicine, or other healthcare professions within health institutions or universities in the GBA of China; (3) prior experience in healthcare delivery or health-related research; and (4) access to mobile devices or network facilities during the study period. Exclusion criteria were: (1) current involvement in other PPIE projects; and (2) presence of severe medical disability or impaired cognitive function.

Eligible participants were provided with a detailed explanation of the study aims and methods, and informed consent was obtained from those who agreed to participate. An online questionnaire was administered, and data collection continued until a minimum response rate of 40% was achieved. After piloting, the survey was made public in December 2024 and closed in April 2025, allowing 3 weeks for responses to be collected.

Data Analysis

Data were analyzed using SPSS Statistics (version 31.0.2.0). Descriptive statistics (frequencies and percentages) were used to summarize participants' characteristics and responses. To compare outcomes across the three regions (Guangdong, Hong Kong, Macao), the Cochran-Mantel-Haenszel (CMH) chi-square test was employed. This test was used to assess the association between region and PPIE-related outcomes, while stratifying by age group, educational level, and period of clinical experience. These stratification variables were chosen as they are known potential confounders and their distributions varied significantly across the three regions. A two-sided p-value of < 0.05 was considered statistically significant.

3 RESULTS

Participant characteristics

A total of 740 HCPs and researchers across the GBA of China were invited to complete the questionnaire. Of these, 344 responses were excluded as invalid (one declined consent, 38 lacked relevant experience in healthcare or health-related research, and 305 did not complete the questionnaire). A total of 396 valid questionnaires were included in the final analysis (Guangdong Province, n = 163; Hong Kong, n = 124; Macao, n = 109), giving a response rate of 53.5%, which exceeded the minimum required sample size.

Table 1 presents the demographic and professional characteristics of participants by region. Significant regional differences were observed in age, educational level, workplace, professional position, and period of clinical experience ($p < 0.05$). Participants from Guangdong Province were predominantly aged 30–39 years (52.8%) and held Bachelor's degrees (61.3%), with most working in public health institutions (95.1%). In contrast, participants from Hong Kong and Macao were mainly aged 18–29 years (78.3% and 79.8%, respectively) and held Master's degrees (51.6% and 64.2%, respectively), with employment concentrated in educational institutions (69.4% and 49.5%, respectively). Nursing was the most common profession overall (56.1%), with the highest representation in Macao (80.8%). Clinical experience of 1–5 years was prevalent across all regions, although Hong Kong (33.1%) and Macao (27.5%) had higher proportions of participants with no clinical experience than Guangdong Province (4.3%). The number of research projects led as principal investigator did not differ significantly across regions, with most participants having led either 0 (43.9%) or 1–5 (53.5%) projects.

Table 1
Demographic and professional characteristics of participants in the GBA of China (N = 396)

Age	**Overall (n = 396), n (%)**	**Guangdong Province, China (n = 163), n (%)**	**Hong Kong (n = 124), n (%)**	**Macao (n = 109), n (%)**	**$\chi 2$**	**p-value**
					147.64[+]	**< 0.05[+]**
18–29	217 (54.8)	33 (20.2)	97 (78.3)	87 (79.8)		
30–39	123 (31.1)	86 (52.8)	19 (15.3)	18 (16.5)		
40–49	41 (10.4)	35 (21.5)	3 (2.4)	3 (2.8)		
50–59	11 (2.8)	9 (5.5)	2 (1.6)	0 (0.0)		
> 60	4 (1.0)	0 (0.0)	3 (2.4)	1 (0.9)		
Gender					3.86	0.15
Male	98 (24.7)	47 (28.8)	31 (25.0)	20 (18.3)		
Female	298(75.3)	116 (71.2)	93 (75.0)	89 (81.6)		
Educational level					98.99[+]	< 0.05[+]
Tertiary or less	4 (1.1)	2 (1.2)	1 (0.8)	1 (0.9)		
Bachelor	153 (38.6)	100 (61.3)	21 (16.9)	32 (29.4)		
Master	191 (48.2)	57 (35.0)	64 (51.6)	70 (64.2)		
Doctor	48 (12.1)	4 (2.5)	38 (30.7)	6 (5.5)		
Workplace					218.66	< 0.05
Public health institutions	210 (53.0)	155 (95.1)	27 (21.8)	28 (25.7)		
Private health institutions	28 (7.1)	3 (1.8)	6 (4.8)	19 (17.4)		
Educational institutions	144 (36.4)	4 (2.5)	86 (69.4)	54 (49.5)		
Others	14 (3.5)	1 (0.6)	5 (4.0)	8 (7.4)		
Professional position					97.24	< 0.05
Medicine	45 (11.4)	27 (16.6)	16 (12.9)	2 (1.8)		
Nursing	222 (56.1)	91 (55.8)	43 (34.7)	88 (80.8)		
Allied health professions	20 (5.0)	6 (3.7)	14 (11.3)	0 (0.0)		
Public health	21 (5.3)	3 (1.8)	15 (12.1)	3 (2.8)		
Pharmacy	21 (5.3)	9 (5.5)	10 (8.1)	2 (1.8)		
Mental health	9 (2.3)	1 (0.6)	7 (5.6)	1 (0.9)		
Nutrition and dietetics	12 (3.0)	5 (3.1)	5 (4.0)	2 (1.8)		
Dentistry	15 (3.8)	7 (4.3)	3 (2.4)	5 (4.6)		
Health administration and management	15 (3.8)	12 (7.4)	3 (2.4)	0 (0.0)		
Others	16 (4.0)	2 (1.2)	8 (6.5)	6 (5.5)		
Period of clinical experience					99.93[+]	< 0.05[+]
0	78 (19.7)	7 (4.3)	41 (33.1)	30 (27.5)		
1–5 years	181 (45.7)	59 (36.2)	65 (52.4)	57 (52.3)		
6–10 years	84 (21.2)	56 (34.6)	9 (26.3)	19 (17.4)		

Age	Overall (n = 396), n (%)	Guangdong Province, China (n = 163), n (%)	Hong Kong (n = 124), n (%)	Macao (n = 109), n (%)	$\chi 2$	p-value
					147.64[+]	**< 0.05[+]**
11–15 years	35 (8.8)	29 (17.8)	4 (3.2)	2 (1.8)		
16–20 years	4 (1.0)	3 (1.8)	1 (0.8)	0 (0.0)		
21–25 years	4 (1.0)	4 (2.5)	0 (0.0)	0 (0.0)		
> 25 years	10 (2.6)	5 (3.1)	4 (3.2)	1 (0.9)		
Period of research experience in health-related topics					16.14[+]	0.05[+]
0	50 (12.6)	22 (13.5)	11 (8.9)	17 (15.6)		
1–5 years	280 (70.7)	103 (63.2)	95 (76.6)	82 (75.2)		
6–10 years	53 (13.4)	31 (19.0)	15 (12.1)	7 (6.4)		
11–15 years	8 (2.0)	4 (2.5)	1 (0.8)	3 (2.8)		
16–20 years	3 (0.8)	2 (1.2)	1 (0.8)	0 (0.0)		
21–25 years	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)		
> 25 years	2 (0.5)	1 (0.6)	1 (0.8)	0 (0.0)		
Number of research projects led as a principal investigator					12.30[+]	0.25[+]
0	174 (43.9)	66 (40.5)	62 (50.0)	46 (42.2)		
1–5	212 (53.5)	91 (55.8)	59 (47.6)	62 (56.9)		
6–10	7 (1.8)	6 (3.7)	0 (0.0)	1 (0.9)		
> 10	3 (0.8)	0 (0.0)	3 (2.4)	0 (0.0)		

Note

PPIE: Patient and public involvement and engagement;

The GBA of China: The Greater Bay Area of China

$\chi 2$: Pearson's chi-square test;

+: Fisher-Freeman-Halton exact test was used for variables with expected frequencies < 5;

P-value: p-values < 0.05 is considered statistically significant.

Knowledge, experience, attitudes, and interest in PPIE training

Table 2 summarizes participants' prior experience with PPIE, their knowledge and attitudes, and their readiness and interest in PPIE training. All regional comparisons were performed using the Cochran–Mantel–Haenszel (CMH) chi-square test, stratified by age group, educational level, and period of clinical experience.

Table 2
A Participants' experiences on PPIE

Contents	Overall (n = 396), n (%)	Guangdong Province, China (n = 163), n (%)	Hong Kong (n = 124), n (%)	Macao (n = 109), n (%)	CMH χ^2	p-value
Whether any experience with PPIE in health-related research?					5.20	0.07
Yes	124 (31.3)	19 (11.7)	57 (46.0)	48 (44.0)		
No	272 (68.7)	144 (88.3)	67 (54.0)	61 (56.0)		
Number of research projects using PPIE over the past five years?					5.77	0.06
0	279 (70.5)	143 (87.7)	67 (54.0)	69 (63.3)		
1–5	117 (29.5)	20 (12.3)	57 (46.0)	40 (36.7)		
6–10	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)		
> 10	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)		
Whether currently involved in other PPIE projects?					3.73	0.16
Yes	63 (15.9)	11 (6.7)	26 (21.0)	26 (23.9)		
No	333 (84.1)	152 (93.3)	98 (79.0)	83 (76.1)		
Whether institutions prioritize PPIE in health-related research?					1.48	0.48
Yes	185 (46.7)	50 (30.7)	70 (56.5)	65 (59.6)		
No	211 (53.3)	113 (69.3)	54 (43.5)	44 (40.4)		
Table 2B Participants' description of what extent of knowledge, understanding, value, confidence and importance of PPIE						
Contents	**Overall (n = 396), n (%)**	**Guangdong Province, China (n = 163), n (%)**	**Hong Kong (n = 124), n (%)**	**Macao (n = 109), n (%)**	**CMH χ^2**	**p-value**
To what extent do you understand PPIE?					8.24	0.41
Not at all	80 (20.0)	48 (29.4)	16 (12.9)	16 (14.7)		
Little understanding	162 (40.9)	90 (55.2)	39 (31.5)	33 (30.3)		
Some understanding	118 (29.8)	20 (12.3)	51 (41.1)	47 (43.1)		
High understanding	35 (8.8)	5 (3.1)	17 (13.7)	13 (11.9)		
Full understanding	1 (0.3)	0 (0.0)	1 (0.8)	0 (0.0)		
To what extend do you adoption and implement PPIE match your professional values?					15.88	< 0.05
Not at all	21 (5.3)	7 (4.3)	9 (7.3)	5 (4.6)		
Slightly consistent	47 (11.9)	34 (20.9)	11 (8.9)	2 (1.8)		
Moderately consistent	155 (39.1)	69 (42.3)	46 (37.1)	40 (36.7)		
Very consistent	131 (33.1)	42 (25.8)	45 (36.3)	44 (40.4)		
Completely consistent	42 (10.6)	11 (6.7)	13 (10.5)	18 (16.5)		
To what extent were the importance of PPIE to health-related research?					16.28	< 0.05
Not at all	10 (2.5)	4 (2.5)	5 (4.0)	1 (0.9)		

Contents	Overall (n = 396), n (%)	Guangdong Province, China (n = 163), n (%)	Hong Kong (n = 124), n (%)	Macao (n = 109), n (%)	CMH χ^2	p-value
Slightly important	38 (9.6)	30 (18.4)	5 (4.0)	3 (2.8)		
Moderately important	136 (34.3)	64 (39.3)	42 (33.9)	30 (27.5)		
Very important	157 (39.6)	55 (33.7)	52 (41.9)	50 (45.9)		
Extremely important	55 (13.9)	10 (6.1)	20 (16.1)	25 (22.9)		
To what extent were the confidence of PPIE to health-related research?					25.11	< 0.05
Not at all	18 (4.5)	10 (6.1)	7 (5.6)	1 (0.9)		
Slightly confident	91 (23.0)	61 (37.4)	19 (15.3)	11 (10.1)		
Moderately confident	128 (32.3)	45 (27.6)	50 (40.3)	33 (25.8)		
Very confident	135 (34.1)	41 (25.2)	41 (33.1)	53 (48.6)		
Extremely confident	24 (6.1)	6 (3.7)	7 (5.6)	11 (10.1)		

Table 2C Participants' description of what extent of the preparation, behaviors and interest in training courses on PPIE

Contents	Overall (n = 396), n (%)	Guangdong Province, China (n = 163), n (%)	Hong Kong (n = 124), n (%)	Macao (n = 109), n (%)	CMH χ^2	p-value
To what extent do you ready to use PPIE in health-related research?					11.02	0.20
Not at all	42 (10.6)	25 (15.3)	10 (8.1)	7 (6.4)		
Low readiness	175 (44.2)	95 (58.3)	42 (33.9)	38 (34.9)		
Somewhat readiness	118 (29.8)	26 (16.0)	54 (43.5)	38 (34.9)		
Quite a readiness	51 (12.9)	15 (9.2)	15 (12.1)	21 (19.3)		
Fully readiness	10 (2.5)	2 (1.2)	3 (2.4)	5 (4.6)		
To what extent do you have plans to involve PPIE in health-related research?					3.93	0.86
Not at all	50 (12.6)	27 (16.6)	12 (9.7)	11 (10.1)		
Rarely involve	101 (25.5)	46 (28.2)	28 (22.6)	27 (24.8)		
Occasional involve	139 (35.1)	61 (37.4)	44 (35.5)	34 (31.2)		
Actively involve	81 (20.5)	23 (14.1)	29 (23.4)	29 (26.6)		
Very actively involve	25 (6.3)	6 (3.7)	11 (8.9)	8 (7.3)		
To what extent are you interested in attending PPIE training courses?					25.22	< 0.05
Not at all	10 (2.5)	2 (1.2)	6 (4.8)	2 (1.8)		
Slightly interested	66 (16.7)	37 (22.7)	20 (16.1)	9 (8.3)		
Moderately interested	174 (43.9)	80 (49.1)	58 (46.8)	36 (33.0)		
Very interested	100 (25.3)	34 (20.9)	29 (23.4)	37 (33.9)		
Extremely interested	46 (11.6)	10 (6.1)	11 (8.9)	25 (22.9)		

Note

PPIE: Patient and public involvement and engagement;

CMH χ^2: Cochran–Mantel–Haenszel (CMH) chi-square test, adjusted for age group and educational level group;

Contents	Overall (n = 396), n (%)	Guangdong Province, China (n = 163), n (%)	Hong Kong (n = 124), n (%)	Macao (n = 109), n (%)	CMH χ^2	p-value
P-value: p-values < 0.05 is considered statistically significant.						

Overall, 68.7% of participants reported no previous PPIE experience in health-related research (Table 2A). The disparity across regions was marked: 88.3% of participants in Guangdong Province reported no prior PPIE experience, compared with 54.0% in Hong Kong and 56.0% in Macao (CMH $\chi^2 = 5.20$, $p = 0.07$). Over the past five years, 70.5% of participants had not participated in any PPIE research project, while 29.5% had conducted between one and five such projects. Current involvement in PPIE projects was reported by 15.9% of participants, with higher engagement in Macao (23.9%) and Hong Kong (21.0%) than in Guangdong Province (6.7%) (CMH $\chi^2 = 3.73$, $p = 0.16$). In addition, 46.7% of participants indicated that their institutions prioritised the adoption and implementation of PPIE in health-related research, with higher proportions in Hong Kong (56.5%) and Macao (59.6%) than in Guangdong Province (30.7%) (CMH $\chi^2 = 1.48$, $p = 0.48$).

Participants generally reported limited familiarity with PPIE (Table 2B). Across the three regions, the largest proportion (40.9%) reported "little understanding," followed by "some understanding" (29.8%), while 20.0% reported "not at all." Although the overall level of understanding did not differ significantly across regions (CMH $\chi^2 = 8.24$, $p = 0.41$), descriptive patterns were notable: the proportion reporting "little understanding" was highest in Guangdong Province (55.2%), whereas Hong Kong and Macao had higher proportions reporting "some understanding" (41.1% and 43.1%, respectively).

Significant regional differences were identified in several attitudinal domains. Perceived consistency between PPIE and participants' professional values differed significantly (CMH $\chi^2 = 15.88$, $p < 0.05$), with the highest proportion rating this consistency as "very" or "completely" consistent in Macao (56.9%), followed by Hong Kong (46.8%) and Guangdong Province (32.5%). The perceived importance of PPIE to health-related research also varied significantly by region (CMH $\chi^2 = 16.28$, $p < 0.05$): 97.5% of participants across the three regions considered PPIE important, with Macao having the highest proportion rating PPIE as "extremely important" (22.9%), compared with Hong Kong (16.1%) and Guangdong Province (6.1%); conversely, Guangdong Province had the highest proportion rating it as "slightly important" (18.4%). Confidence in applying PPIE to health-related research also differed significantly (CMH $\chi^2 = 25.11$, $p < 0.05$): Macao reported the highest proportion of "very confident" participants (48.6%), followed by Hong Kong (33.1%) and Guangdong Province (25.2%), whereas the proportion of "slightly confident" participants was greatest in Guangdong Province (37.4%).

Neither the level of readiness to use PPIE nor plans to involve PPIE in future health-related research reached statistical significance across regions (CMH $\chi^2 = 11.02$ and 3.93, respectively; both $p > 0.05$) (Table 2C). Nevertheless, the largest proportion of participants (44.2%) reported a low level of readiness, and this response was most prevalent in Guangdong Province (58.3%), compared with Hong Kong (33.9%) and Macao (34.9%). Regarding plans to involve PPIE in future research, 20.5% of participants reported active involvement, which was slightly more common in Macao (26.6%) and Hong Kong (23.4%) than in Guangdong Province (14.1%).

Interest in attending PPIE training courses differed significantly among the three regions (CMH $\chi^2 = 25.22$, $p < 0.05$). The vast majority of participants (97.5%) expressed interest in attending such a course. The most common response was "moderately interested" across all regions, particularly among participants from Guangdong Province (49.1%) and Hong Kong (46.8%), both of which exceeded the overall average; a considerable proportion of participants from Macao (33.9%) reported being "very interested."

Perceived facilitators and barriers to PPIE adoption and implementation

Table 3 summarises participants' perspectives on the facilitators of and barriers to the adoption and implementation of PPIE in health-related research. The three most frequently endorsed facilitators were improvement of participant recruitment (66.9%), enhancement of trust between HCPs or researchers and patients or the public (62.6%), and improvement of healthcare quality (61.6%) (Table 3A). Significant regional differences were observed for eight facilitators: provision of adequate background information for health-related projects (CMH $\chi^2 = 14.08$, $p < 0.05$); improvement of participant recruitment (CMH $\chi^2 = 7.92$, $p < 0.05$); promotion of public health awareness (CMH $\chi^2 = 6.47$, $p < 0.05$); contribution to funding applications (CMH $\chi^2 = 22.64$, $p < 0.05$); improvement of findings dissemination (CMH $\chi^2 = 18.80$, $p < 0.05$); improvement in the relevance of health-related research and practice to the actual needs of patients and the public (CMH $\chi^2 = 17.53$, $p < 0.05$); improvement in the knowledge and skills of HCPs and researchers (CMH $\chi^2 = 19.27$, $p < 0.05$); and acquisition of a new perspective on a health-related topic (CMH $\chi^2 = 27.91$, $p < 0.05$). For all eight facilitators, participants from Guangdong Province reported the highest proportions (60.1%, 71.8%, 59.5%, 41.7%, 47.2%, 62.6%, 51.5%, and 65.6%, respectively), all exceeding the overall averages. In Hong Kong, improvement of participant recruitment was the most frequently identified benefit (58.9%); in Macao, provision of adequate background information was most commonly endorsed (72.5%), followed by Guangdong Province (60.1%) and Hong Kong (53.2%).

Table 3
A Perceived facilitators to the adoption and implementation of PPIE

Contents	Overall (n = 396), n (%)	Guangdong Province, China (n = 163), n (%)	Hong Kong (n = 124), n (%)	Macao (n = 109), n (%)	CMH χ^2	p-value
The benefits that PPIE brings to health-related research (multiple choices question)						
No benefits	3(0.8)	0 (0.0)	1 (0.8)	2 (1.8)	3.58	0.17
Provision of adequate background information for health-related projects	243 (61.4)	98 (60.1)	66 (53.2)	79 (72.5)	14.08	< 0.05
Improvement of participant recruitment	265 (66.9)	117 (71.8)	73 (58.9)	75 (68.8)	7.92	< 0.05
Improvement of the quality of healthcare professionals/researchers	244 (61.6)	94 (57.7)	75 (60.5)	75 (68.8)	2.03	0.36
Promotion of scientific decision-making	220 (55.6)	74 (45.5)	70 (56.5)	76 (69.7)	4.53	0.10
Trust enhancement between and patients/the public	248 (62.6)	104 (63.8)	68 (54.8)	76 (69.7)	3.98	0.14
Promotion of public health awareness	236 (59.6)	97 (59.5)	61 (49.2)	78 (71.6)	6.47	< 0.05
Contributing to funding applications	116 (29.3)	68 (41.7)	19 (15.3)	29 (26.6)	22.64	< 0.05
Improvement of study design	153 (38.6)	77 (47.2)	41 (33.1)	35 (32.1)	4.33	0.12
Improvement of finding dissemination	154 (38.9)	77 (47.2)	31 (25.0)	46 (42.2)	18.80	< 0.05
Improvement in the relevance of health-related research and practice to the actual needs of patients and the public	224 (56.6)	102 (62.6)	53 (42.7)	69 (63.3)	17.53	< 0.05
Improvement in the knowledge and skills of healthcare professionals and researchers	178 (44.9)	84 (51.5)	36 (29.0)	58 (53.2)	19.27	< 0.05
The acquisition of a new perspective on a health-related topic	199 (50.3)	107 (65.6)	37 (29.8)	45 (41.3)	27.91	< 0.05
Other benefits	1 (0.3)	0 (0.0)	1 (0.8)	0 (0.0)	1.74	0.42
Factors that can motivate the application of PPIE in health-related research (multiple choices question)						
Research fund/funder requirements	193 (48.7)	69 (42.3)	71 (57.3)	53 (48.6)	3.84	0.15
Desire to gain knowledge of healthcare	220 (55.6)	110 (67.5)	51 (41.1)	59 (54.1)	21.83	< 0.05
An opportunity to help others	244 (61.6)	100 (61.3)	59 (47.6)	85 (78.0)	14.21	< 0.05
Invitation from health-related institutions or communities	206 (52.0)	94 (57.7)	52 (41.9)	60 (55.0)	17.36	< 0.05
Supported policy and healthcare system	234 (59.1)	106 (65.0)	54 (43.5)	74 (67.9)	19.68	< 0.05
Rewards or incentives	266 (67.2)	126 (77.3)	69 (55.6)	71 (65.1)	9.29	< 0.05
Better research outcomes	262(66.2)	119 (73.0)	76 (61.3)	67 (61.5)	3.99	0.14

Contents	Overall (n = 396), n (%)	Guangdong Province, China (n = 163), n (%)	Hong Kong (n = 124), n (%)	Macao (n = 109), n (%)	CMH χ^2	p-value
The benefits that PPIE brings to health-related research (multiple choices question)						
Attendance of some PPIE training	160 (40.4)	90 (55.2)	26 (21.0)	44 (40.4)	27.45	< 0.05
Others	1 (0.3)	0 (0.0)	0 (0.0)	1 (0.9)	0.83	0.66
The benefits of promoting PPIE in health-related research by the government and health institutions (multiple choices question)						
Formulate relevant policies and regulations	180 (45.5)	76 (46.6)	52 (41.9)	52 (47.7)	1.16	0.56
Increase investment in health-related research	272 (68.7)	118 (72.4)	77 (62.1)	77 (70.6)	9.20	< 0.05
Strengthen PPIE publicity	290 (73.2)	128 (78.5)	75 (60.5)	87 (79.8)	16.77	< 0.05
Provide project funding for PPIE activities	268 (67.7)	116 (71.2)	67 (54.0)	85 (78.0)	21.05	< 0.05
Establish convenient channels and platforms for participation into PPIE projects	232 (58.6)	108 (66.3)	62 (50.0)	62 (56.9)	6.01	0.05
Strengthen collaborations among researchers, healthcare professionals, communities, and social organizations	283 (71.5)	126 (77.3)	74 (59.7)	83 (76.1)	8.02	< 0.05
Develop professional tools to facilitate PPIE utilization	238 (60.1)	113 (69.3)	52 (41.9)	73 (67.0)	20.22	< 0.05
Give specific rewards to PPIE contributors	208 (52.5)	107 (65.6)	50 (40.3)	51 (46.8)	12.4	< 0.05
Provide more health education and training for healthcare professionals and researchers	217 (54.8)	106 (65.0)	53 (42.7)	58 (53.2)	6.62	< 0.05
Others	1 (0.3)	0 (0.0)	1 (0.8)	0 (0.0)	0.57	0.75
The stages that would be beneficial to involve and engage patient and public (multiple choices question)						
Identification of research/practical problems	221(55.6)	90 (55.2)	64 (51.6)	67 (61.5)	2.55	0.28
Development of research/practical objectives	224 (55.6)	98 (60.1)	66 (53.2)	60 (55.0)	1.64	0.44
Discussion of methods	212 (53.5)	90 (55.2)	60 (48.4)	62 (56.9)	2.31	0.32
Implementation of a project	236 (59.6)	100 (61.3)	70 (56.5)	66 (60.6)	2.34	0.31
Data analysis and/or interpretation of results	197 (49.7)	82 (50.3)	56 (45.2)	59 (54.1)	3.65	0.16
Dissemination of project outcomes	211 (53.3)	100 (61.3)	48 (38.7)	63 (57.8)	13.56	< 0.05
Others	2 (0.5)	0 (0.0)	2 (1.6)	0 (0.0)	**	**

Table 3B Barriers to the adoption and implementation of PPIE

Contents	Overall (n = 396), n (%)	Guangdong Province, China (n = 163), n (%)	Hong Kong (n = 124), n	Macao (n = 109), n (%)	CMH χ^2	p-value

Contents	Overall (n = 396), n (%)	Guangdong Province, China (n = 163), n (%)	Hong Kong (n = 124), n (%)	Macao (n = 109), n (%)	CMH χ^2	p-value
The benefits that PPIE brings to health-related research (multiple choices question)						
			(%)			
The challenges that may be faced in adopting and implementing PPIE in health-related research (multiple choices question)						
No challenges	3 (0.8)	2 (1.2)	0 (0.0)	1 (0.9)	0.18	0.91
Uncertainty about how to adopt or implement PPIE	315 (79.5)	127 (77.9)	98 (79.0)	90 (82.6)	0.14	0.93
Difficulties in identifying relevant research or practical issues	203 (51.3)	94 (57.7)	52 (41.9)	57 (52.3)	11.64	< 0.05
Ethical concerns about involving and engaging patients and the public	243 (61.4)	107 (65.6)	66 (53.2)	70 (64.2)	22.61	< 0.05
Patients' limited understanding of the complexity of the health topic	253 (63.9)	103 (63.2)	73 (58.9)	77 (70.6)	2.60	0.27
Distrust of patients' or the public's contributions	172 (43.4)	97 (59.5)	36 (29.0)	39 (35.8)	23.15	< 0.05
Difficulties in communicating scientific and professional knowledge to patients and the public	224 (56.6)	125 (76.7)	47 (37.9)	52 (47.7)	28.14	< 0.05
Insufficient time	212 (53.5)	126 (77.3)	36 (29.0)	50 (45.9)	30.61	< 0.05
Limited resources	252 (63.6)	125 (76.7)	68 (54.8)	59 (54.1)	9.44	< 0.05
Others	1 (0.3)	0 (0.0)	1 (0.8)	0 (0.0)	0.18	0.91
The importance of providing compensation to PPIE members involved in health-related research						
Not at all	5 (1.3)	0 (0.0)	2 (1.6)	3 (2.8)	17.76	< 0.05
Slightly important	25 (6.3)	13 (8.0)	9 (7.3)	3 (2.8)		
Moderately important	149 (37.6)	73 (44.8)	41 (33.1)	35 (32.1)		
Very important	174 (43.9)	70 (42.9)	56 (45.2)	48 (44.0)		
Extremely important	43 (10.9)	7 (4.3)	16 (12.9)	20 (18.3)		

Note

PPIE: Patient and public involvement and engagement;

CMH χ^2: Cochran–Mantel–Haenszel (CMH) chi-square test, adjusted for age group, educational level group and period clinical experience group, For variables with expected cell counts < 5;[

**: Due to the limited sample size and excessively sparse cells after joint stratification by age group, educational level, and clinical experience, the CMH chi-square test could not be reliably estimated;

P-value: p-values < 0.05 is considered statistically significant.

Several motivators also demonstrated significant regional differences. The desire to gain knowledge of healthcare (CMH $\chi^2 = 21.83$, $p < 0.05$) was most common in Guangdong Province (67.5%) and least common in Hong Kong (41.1%). The opportunity to help others (CMH $\chi^2 = 14.21$, $p < 0.05$) was endorsed by 78.0% of Macao participants, 61.3% in Guangdong Province, and 47.6% in Hong Kong. Invitations from health institutions or communities (CMH $\chi^2 = 17.36$, $p < 0.05$), supportive policy and healthcare systems (CMH $\chi^2 = 19.68$, $p < 0.05$), and rewards or incentives (CMH $\chi^2 = 9.29$, $p < 0.05$) also exhibited significant regional variation, with Guangdong Province and Macao generally

reporting higher proportions than Hong Kong. Attendance at PPIE training differed significantly (CMH $\chi^2 = 27.45$, $p < 0.05$), with 55.2% of Guangdong participants, 40.4% in Macao, and only 21.0% in Hong Kong reporting participation. No significant differences were found for funder requirements or improved research outcomes.

Significant regional differences were also identified for governmental and institutional support measures. These included increased investment in health-related research (CMH $\chi^2 = 9.20$, $p < 0.05$), enhanced PPIE publicity (CMH $\chi^2 = 16.77$, $p < 0.05$), provision of project funding for PPIE activities (CMH $\chi^2 = 21.05$, $p < 0.05$), strengthened collaborations (CMH $\chi^2 = 8.02$, $p < 0.05$), development of professional tools (CMH $\chi^2 = 20.22$, $p < 0.05$), specific rewards for PPIE contributors (CMH $\chi^2 = 12.40$, $p < 0.05$), and increased health education and training (CMH $\chi^2 = 6.62$, $p < 0.05$). For nearly all these measures, participants from Guangdong Province and Macao reported higher endorsement rates than those from Hong Kong. No significant regional difference was observed in the formulation of relevant policies. Regarding the stages of patient and public involvement, only the dissemination of project outcomes stage showed a significant regional difference (CMH $\chi^2 = 13.56$, $p < 0.05$), with higher endorsement in Guangdong Province (61.3%) and Macao (57.8%) than in Hong Kong (38.7%). All other stages showed no significant differences.

Table 3B summarizes the potential barriers to the adoption and implementation of PPIE as identified by participants from the three regions. Most challenges were reported consistently across regions, with no significant differences for uncertainty about adopting PPIE (79.5% overall) and patients' limited understanding (63.9%). However, several barriers demonstrated significant regional variation. Difficulties in identifying relevant research or practical issues (CMH $\chi^2 = 11.64$, $p < 0.05$) were most frequently reported in Guangdong Province (57.7%) and least in Hong Kong (41.9%). Ethical concerns (CMH $\chi^2 = 22.61$, $p < 0.05$) were most prevalent in Guangdong Province (65.6%) and Macao (64.2%), and least in Hong Kong (53.2%). Distrust of patients' or the public's contributions (CMH $\chi^2 = 23.15$, $p < 0.05$) was substantially higher in Guangdong Province (59.5%) compared with Hong Kong (29.0%) and Macao (35.8%). Difficulties in communicating scientific knowledge (CMH $\chi^2 = 28.14$, $p < 0.05$) were most pronounced in Guangdong Province (76.7%), followed by Macao (47.7%) and Hong Kong (37.9%). Insufficient time (CMH $\chi^2 = 30.61$, $p < 0.05$) and limited resources (CMH $\chi^2 = 9.44$, $p < 0.05$) also varied significantly, with Guangdong participants reporting the highest levels (77.3% and 76.7%, respectively), while Hong Kong and Macao reported lower but still considerable proportions.

A significant regional difference was also observed regarding the perceived importance of providing compensation to PPIE members (CMH $\chi^2 = 17.76$, $p < 0.05$). Macao participants assigned the highest importance to compensation, with 18.3% rating it as "extremely important" and 44.0% as "very important." In comparison, only 4.3% of Guangdong participants considered it extremely important. Hong Kong participants rated compensation as "extremely important" (12.9%) and "very important" (45.2%), positioning them between Macao and Guangdong Province.

Perceived future development of PPIE

Table 4 presents participants' perspectives on the prospects of PPIE, anticipated outcomes, and willingness to participate in training or conduct PPIE research. A significant regional difference emerged in participants' assessments of the future development prospects of PPIE (CMH $\chi^2 = 17.76$, $p < 0.05$). Most participants considered the prospects to be moderately (36.1%), very (37.9%), or extremely promising (16.4%). Guangdong participants most frequently rated the prospects as "moderately promising" (47.9%), whereas participants from Hong Kong and Macao were more likely to rate them as "very promising" (41.9% and 46.8%, respectively) or "extremely promising" (21.8% and 22.9%, respectively). In contrast, 14.7% of Guangdong participants rated the prospects as "slightly promising," compared with 6.5% in Hong Kong and 1.8% in Macao.

Table 4
Participants' responses in the perceived future development of PPIE in health-related research

Contents	Overall (n = 396), n (%)	Guangdong Province, China (n = 163), n (%)	Hong Kong (n = 124), n (%)	Macao (n = 109), n (%)	CMH χ^2	p-value
The future development prospects of PPIE in health-related research					17.76	< 0.05
Not at all promising	4 (1.0)	1 (0.6)	1 (0.8)	2 (1.8)		
Slightly promising	34 (8.6)	24 (14.7)	8 (6.5)	2 (1.8)		
Moderately promising	143 (36.1)	78 (47.9)	36 (29.0)	29 (26.6)		
Very promising	150 (37.9)	47 (28.8)	52 (41.9)	51 (46.8)		
Extremely promising	65 (16.4)	13 (8.0)	27 (21.8)	25 (22.9)		
The expectations for the outcomes to the adoption and implementation of PPIE in health-related research (multiple choices question)						
Efficient decision-making mechanism	185 (46.7)	70 (42.9)	57 (46.0)	58 (53.2)	8.11	< 0.05
Improved research/practice relevance	260 (65.7)	107 (65.6)	79 (63.7)	74 (67.9)	2.91	0.23
Greater patient/public empowerment	286 (72.2)	120 (73.6)	84 (67.7)	82 (75.2)	2.88	0.24
Increased transparency	229 (57.8)	90 (55.2)	73 (58.9)	66 (60.6)	2.33	0.31
Better health outcomes for patients and the public	242 (61.1)	103 (63.2)	62 (50.0)	77 (70.6)	8.08	< 0.05
Stronger trust between healthcare professionals/researchers and patients/the public	266 (67.2)	127 (77.9)	69 (55.6)	70 (64.2)	9.30	< 0.05
More frequent collaborations between healthcare researchers/professionals and patients/the public	228 (57.6)	103 (63.2)	62 (50.0)	63 (57.8)	2.98	0.23
Others	1 (0.3)	0 (0.0)	1 (0.8)	0 (0.0)	**	**
Whether willing to attend PPIE training courses in the future						
Yes	329 (83.1)	129 (99.1)	101 (81.5)	99 (80.8)	2.71	0.26
No	67 (16.9)	34 (20.9)	23 (18.5)	10 (9.2)		
Whether willing to conduct or participate in PPIE research in the future					17.05	< 0.05
Yes	255 (64.4)	74 (45.4)	85 (68.6)	96 (88.1)		
No	138 (34.8)	89 (54.6)	36 (29.0)	13 (11.9)		
No respond	3 (0.8)	0 (0.0)	3 (2.4)	0 (0.0)		

Note

PPIE: Patient and public involvement and engagement;

CMH χ^2: Cochran–Mantel–Haenszel (CMH) chi-square test, adjusted for age group, educational level group and period clinical experience group, For variables with expected cell counts < 5;[

Contents	Overall (n = 396), n (%)	Guangdong Province, China (n = 163), n (%)	Hong Kong (n = 124), n (%)	Macao (n = 109), n (%)	CMH χ^2	p-value

**: Due to the limited sample size and excessively sparse cells after joint stratification by age group, educational level, and clinical experience, the CMH chi-square test could not be reliably estimated;

P-value: p-values < 0.05 is considered statistically significant.

Regarding expectations for the adoption and implementation of PPIE, significant regional differences were observed for three outcome items. First, endorsement of an efficient decision-making mechanism varied by region (CMH $\chi^2 = 8.11$, $p < 0.05$), with Macao participants expressing the highest support (53.2%), followed by Hong Kong (46.0%) and Guangdong Province (42.9%). Second, expectations for improved health outcomes for patients and the public also differed significantly (CMH $\chi^2 = 8.08$, $p < 0.05$), with the highest endorsement in Macao (70.6%), followed by Guangdong Province (63.2%) and Hong Kong (50.0%). Third, the expectation of stronger trust between HCPs or researchers and patients or the public showed a significant regional difference (CMH $\chi^2 = 9.30$, $p < 0.05$), with Guangdong Province reporting the highest proportion (77.9%), followed by Macao (64.2%) and Hong Kong (55.6%). No significant regional differences were identified for other outcome items.

Willingness to participate in future PPIE training courses was nearly universal in Guangdong Province (99.1%) and remained high in Hong Kong (81.5%) and Macao (80.8%). A significant regional difference was identified in participants' willingness to conduct or participate in future PPIE research (CMH $\chi^2 = 17.05$, $p < 0.05$). Overall, 64.4% of participants responded affirmatively. Willingness was highest in Macao (88.1%), followed by Hong Kong (68.6%), and lowest in Guangdong Province (45.4%). In contrast, unwillingness was most prevalent in Guangdong Province (54.6%), compared with Hong Kong (29.0%) and Macao (11.9%).

4 DISCUSSION

We conducted a comparative analysis to assess differences between HCPs and researchers in their understanding of the concept, knowledge levels, practical experience, and attitudes toward PPIE. Most HCPs and researchers in the GBA of China have limited experience with adopting and implementing PPIE in health-related research. Although PPIE is generally regarded as valuable and important, its adoption and application in health-related research remain inconsistent across the region.

While PPIE is relatively mature and well-established in health-related research within Western countries, its adoption and implementation remain nascent across many Asian countries and regions [21]. In Singapore and Hong Kong, for instance, the incorporation of patient perspectives and public participation into research has only recently begun to gain traction [22, 23]. In mainland China, PPIE is still in an early developmental stage [24], which aligns with the results of our study. One important reason for this difference is that, unlike Western countries, China has not yet widely adopted the PPIE requirements for academic publishing. This is consistent with the results reflected by our data, especially in Guangdong Province. Leading international journals, such as The BMJ and the Journal of Advanced Nursing, now require authors to include PPIE statements in their submissions [25, 26]. However, prominent Chinese publications, including the South China Journal of Preventive Medicine and the Journal of Nursing (China), have not yet instituted similar mandates [27, 28]. In 2020, only 3.4% of BMJ Open articles originating from China included PPIE, compared with 44.5% of those from the UK [14]. This limited emphasis on PPIE research in the academic publishing landscape of China, together with cultural norms that have traditionally favoured expert-led approaches, often constrains or neglects the involvement of HCPs and researchers in conducting PPIE research. Consequently, the absence of established PPIE frameworks and insufficient academic institutional support impede the adoption and implementation of PPIE into health-related research in China.

Additionally, this study identifies an additional factor contributing to the low rate of public participation in health-related research. In contrast to countries with established PPIE practices, such as the UK, the scientific research funding system in China does not mandate PPIE for project applications or evaluations [29]. Data indicate that only 27.4% of domestic HCPs inform patients of research results, and nearly 36% of studies lack any patient participation [30]. Many health institutions in Guangdong Province prioritize research focused on experimental trials [31, 32], which contributes to the limited adoption and implementation of PPIE in health-related research. These findings are consistent with survey results, which indicate that most participants from Guangdong Province have limited experience with PPIE research. Although research suggests that Hong Kong and Macao possess some PPIE research experience, it remains insufficient in practice. Existing mature PPIE frameworks, such as the NIHR framework, originate from Western contexts [1]. There is a notable absence of patient inclusion criteria, participation pathways, and ethical regulatory guidelines tailored to the complex institutional environment of the GBA of China. As a result, experience with PPIE research among HCPs and researchers remains limited.

These gaps may arise from differences in healthcare systems, research cultures, and the maturity of participatory practices. Education and training are acknowledged as essential components for the establishment of enduring health policies and practices [33], offering fundamental health knowledge that can potentially mitigate healthcare expenditures (Jankelová et al., 2021). Enhancing PPIE-related knowledge and skills among HCPs and researchers can improve their ability to conduct inclusive, patient-relevant research, thereby increasing patient and public outcomes, satisfaction, and recovery [34, 35]. Although most participants expressed strong interest in PPIE training, the current lack of systematic education remains a major barrier to the PPIE concept and practical experience. As a result, many HCPs and researchers are unfamiliar with PPIE which aligns with the broader literature, which emphasizes the need for dedicated capacity-building initiatives to support effective PPIE [36, 37]. There is an urgent need to develop targeted PPIE educational resources and training programs throughout the GBA of China to translate its conceptual value into practical competence and integrate it into health-related research and professional development.

Moreover, this study identified perceived facilitators and barriers to the implementation of PPIE in health-related research across the GBA of China, based on evidence. Consistent with prior work, our findings demonstrate that sustained PPIE relies on three interrelated facilitators, including effective participant recruitment, appropriately designed incentives, and trust-based partnerships throughout the research lifecycle [38, 39]. Incentives serve to mitigate practical burdens including time costs and financial out-of-pocket expenses, while respectful communication and co-production foster recognition and shared goals among patient and public contributors [40]. Notably, we observed regional divergence in preferred incentive forms. Participants in Guangdong prioritised tangible remuneration due to constrained research budgets, whereas Hong Kong and Macao, with established patient rights infrastructure, placed greater emphasis on relational trust and symbolic recognition. Incorporating incentives and trust-building mechanisms into health-related research, rather than considering them as supplementary elements, can yield more enduring and scalable implementation outcomes across all PPIE initiatives.

Institutional support, leadership endorsement, and dedicated funding have been recognized as critical drivers for the adoption and implementation of PPIE, particularly within the complex health-related research landscape of the GBA of China. More than half of the surveyed participants reported that their health institutions did not prioritize or support PPIE in health-related research. This lack of institutional backing was especially pronounced in Guangdong Province compared to Hong Kong and Macao. Existing literature underscores that institutional culture and policies are key determinants of health-related research and practice [41, 42]. Moreover, insufficient practical experience may impede the understanding and application of participatory research approaches [43]. Studies also show that the absence of institutional and financial support poses significant challenges to research activities [44, 45]. Conversely, institutional support has been shown to enhance the research skills and motivation of HCPs and researchers [44]. Without institutional and policy backing, efforts to implement PPIE are likely to remain fragmented and unsustainable. Consequently, the limited institutional support for PPIE systems in Guangdong Province reduces the motivation and opportunities for HCPs and researchers to adopt and implement PPIE in health-related research.

Meanwhile, barriers to PPIE operated at several levels. Firstly, limited PPIE knowledge and methodological competence, coupled with heavy clinical workloads, impeded researchers' capacity to engage patients and the public authentically [46, 47]. These dimensions collectively shape the capacity and willingness of HCPs and researchers to engage meaningfully in the adoption and implementation of PPIE. As a result, they struggled to communicate scientific and professional knowledge to patients and the public [46, 48]. This uncertainty is largely due to the absence of structured training programs, clear operational guidelines, and practical implementation strategies. Without systematic education or standardized procedures, many HCPs and researchers in the GBA expressed uncertainty about how to effectively involve patients and the public at all stages of research, from choosing topics to sharing results [49]. This is one reason why many HCPs and researchers in the GBA of China have reported a lack of knowledge and skills in conducting PPIE research.

- Secondly, workload limitations constitute a substantial impediment. Evidence indicates that inadequate time presents a significant challenge, especially for HCPs and researchers within the GBA of China. The majority of participants indicated that their daily clinical duties consumed nearly all of their available work hours, thereby restricting opportunities to the adoption and implementation of PPIE within health-related research, particularly in Guangdong Province. Factors contributing to the clinical burden encompass elevated patient-to-provider ratios, prolonged working hours, frequent clinical duties, and considerable administrative and documentation obligations [50, 51]. A study examining time allocation among medical personnel revealed that approximately 56% of their time is dedicated to clinical work, while only 16% is allocated to research activities [47]. This imbalance severely limits the flexible time required for meaningful involvement and engagement of PPIE in health-related research.
- In addition to financial and staffing limitations, policy-related issues, especially ethical and privacy of data requirements, impede PPIE in health-related research throughout the GBA of China. Our findings concurrently illustrate the ethical concerns of participants in Macao regarding the adoption and implementation of PPIE in health-related research.The ethical and data privacy regulations in Macao present a duality of benefits and difficulties. Stringent ethical and data privacy protocols bolster core bioethical principles, encompassing autonomy, non-maleficence, beneficence, and justice, thereby safeguarding patient rights and personal data [52]. These stipulations are

grounded in Macao's legal framework, which aligns with international data protection benchmarks, thereby reflecting a societal commitment to individual privacy and institutional accountability. This framework highlights the distinctions within the healthcare landscape and medical infrastructure of the GBA of China. Meanwhile, the rigour regulatory may constrict research, especially in participatory studies that rely on iterative dialogue, shared decision-making, and adaptable collaboration among HCPs, researchers, patients, and public partners [53, 54]. Ewald et al. (2025) assert that excessive regulatory control could directly undermine the trust-based, equal partnerships that are essential for effective PPIE [55]. Therefore, the core issue isn't whether regulation is needed, but how to adjust its adoption and implementation to support participatory research.

- In reality, several ethics committees throughout the GBA of China indicate a lack of expertise with PPIE procedures and suitable review frameworks for assessing PPIE research. Lacking explicit practical ethical guidelines for PPIE, the execution of ethical review may be hindered, dissuading researchers from integrating PPIE into their study designs and compromising the credibility of participatory methodologies. It is crucial to balance the preservation of patient privacy with the demands of participatory research. Future advancements in PPIE research must take into account the varied legal frameworks and regulatory constraints in the areas of the GBA of China. To ensure both compliance and efficacy, it is suggested that a coordination mechanism for multi-center research be established, alongside the implementation of additional reviews tailored to local conditions, and the creation of a cross-regional ethical supervision council dedicated to long-term patient-participatory research projects.

This study has several strengths. It is to our knowledge that the first mixed-methods study to examine the knowledge, experiences, and attitudes toward PPIE among HCPs and researchers in the GBA of China and to identify perceived facilitators and barriers to its adoption and implementation. The explanatory sequential design combined the breadth of a cross-sectional survey across Guangdong Province, Hong Kong, and Macao with the depth of 18 semi-structured interviews conducted to thematic saturation, enabling meaningful regional comparison and contextual explanation of the quantitative findings. The survey instrument demonstrated strong content validity and acceptable internal consistency.

Several limitations should nonetheless be acknowledged. Although the sample met minimum size requirements, it may not represent all healthcare professionals and researchers in the region, particularly those in private institutions or remote areas, and voluntary participation may have introduced self-selection bias toward individuals already interested in PPIE, potentially overestimating awareness and readiness. Institutional distribution also differed by region, and most Hong Kong and Macao participants were university-affiliated, whereas Guangdong participants were recruited mainly from public hospitals, and the qualitative sample was occupationally imbalanced, with all Macao participants being researchers and most Guangdong participants being clinical staff; observed regional differences may therefore partly reflect professional roles rather than region alone. The cross-sectional design captured perceptions at a single time point and precludes causal inference, and the qualitative sample, predominantly nursing professionals and academic researchers, may not represent the views of other professional groups. In addition, the questionnaire was developed from a literature review and expert input but has not yet undergone full psychometric validation, so findings should be interpreted with caution pending assessment of reliability, construct validity, and reproducibility. Finally, the CICI framework was originally developed for complex clinical interventions; although its application to PPIE was justified, certain dimensions may not fully align with a collaborative research paradigm. Future studies should recruit more diverse and balanced samples, adopt longitudinal designs, and further validate the measurement instrument.

5. CONCLUSION

This first cross-regional survey of HCPs and researchers in the GBA of China shows that PPIE remains at an early stage of adoption and implementation, despite widespread recognition of its value. Although most HCPs and researchers valued PPIE and expressed strong interest in training, prior experience, conceptual understanding, confidence, and resources were limited, with significant regional differences across the GBA of China. Regionally tailored training, dedicated institutional and financial support, clear operational and ethical guidelines, and cross-regional collaboration are needed to translate positive attitudes into sustainable PPIE practice.

Declarations

Clinical trial number

not applicable.

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Author Contribution

X.L designed the study; X. L and X. F wrote the main manuscript; X. F prepared Tables 1–4; C. J and C. C collected the data; J. P and X. L analysed the data; All authors reviewed and approved the final manuscript.

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