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Original Article

Knowledge, attitude and practice of pharmacoepidemiology in paediatric pharmacists: A nationwide questionnaire-based study

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ABSTRACT

Background and Aims: Pharmacoepidemiology evidence are crucial in the development and evaluation of drugs in paediatrics. Data on the knowledge, attitude, and practice (KAP) of paediatric pharmacists regarding pharmacoepidemiology are limited. This study aimed to evaluate the KAP of pharmacoepidemiology in Malaysian paediatric pharmacists.

Methods: A total of 149 paediatric pharmacists from Malaysian public hospitals were invited to participate in this cross-sectional study. Data were collected between April and June 2023 using a self-administered online questionnaire on KAP regarding pharmacoepidemiology. Bloom's cut-off value of ≥ 81% denoted high knowledge, positive attitude, and good practice, respectively. Descriptive and inferential data analyses were performed using SPSS v20.

Results: Ninety-nine paediatric pharmacists (response rate 66.44%; mean age 34.3±3.99 years) participated in this study. The majority (61.62%, n=61) worked at major specialist hospitals, with an overall mean working experience of 5.2±4.29 years. About 22.22% of pharmacists had a high level of knowledge, 15.15% had a positive attitude, but none had a good level of pharmacoepidemiology practice. On-the-job training (89.9%) and networking on paediatric pharmacy research (86.87%) were strongly recommended as key facilitators of pharmacoepidemiology. Knowledge [OR = 1.067, 95% CI (1.023–1.112), p=0.02] and attitude [OR = 1.118, 95% CI (1.044–1.198), p=0.02] scores significantly correlated with pharmacoepidemiology practice.

Conclusion: Paediatric pharmacists demonstrated moderate knowledge, a neutral attitude, but poor practice towards pharmacoepidemiology. Future initiatives should emphasise collaborative efforts among academic institutions, professional bodies and practitioners to address knowledge and attitude through the provision of on-the-job training and networking to enhance pharmacoepidemiology application among paediatric pharmacists in Malaysia.

Keywords: Pharmacoepidemiology, Paediatric, Knowledge, Attitude, Pharmacists

INTRODUCTION

Pharmacoepidemiology is the study of the use and effects of drugs in large numbers of people (Strom, Kimmel, & Hennessy, 2013). In comparison with experimental studies or clinical trials, pharmacoepidemiologic studies have the potential to descriptively evaluate drug use and effects in patients experiencing real-life conditions using data collected retrospectively, prospectively, or cross-sectionally (Montastruc et al., 2019). The ability to evaluate drug use and effects in real-world settings makes pharmacoepidemiologic studies a more suitable approach for generating evidence in populations underrepresented in clinical trials, such as children.

The numerous drugs used in children lack age-specific studies, rendering them unapproved for paediatric use by regulatory authorities. Recruiting children for clinical trials has proven challenging (Lagler, Hirschfeld, & Kindblom, 2021). As a result, pharmacoepidemiologic studies have been employed to assess prescription drug safety (Luo, Doherty, Cappelleri, & Frush, 2007), develop tools for detecting irrational drug use (Prot-Labarthe et al., 2014), evaluate prescription drug-related adverse events (Luo, Cappelleri, & Frush, 2007), and describe dosing practices (Thompson et al., 2020) in children. However, only a minority of healthcare professionals caring for children expressed interest in the epidemiology associated with prescribing and medication use (MacLeod, 2018).

Globally, paediatric pharmacy services operate under different operational models, with the majority being integrated into larger hospitals, while some are freestanding for children (Webster et al., 2019). In Malaysia, paediatric pharmacy services were introduced under the Ministry of Health (MOH) Malaysia's pharmacy programme in 2006. Subsequently, the

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first paediatric pharmacists working group committee was formed in 2009 (Pharmaceutical Services Programme, 2015). The establishment and growth of paediatric pharmacy services are heavily reliant on data-driven attributes, including benchmarking, the anticipated impact on the quality of care and patient safety, interdisciplinary support, national organisation guidelines and costing (Webster et al., 2019). Given the specific indications and limitations of various pharmacoepidemiological study designs, understanding the different methods involved is crucial to ensure optimal use and accurate interpretation of the data (Lasky et al., 2016).

Based on current information, no studies have been conducted to evaluate the knowledge, attitude, and practice (KAP) of paediatric pharmacists in Malaysia regarding the pharmacoepidemiology approach and its application. Consequently, this study was undertaken to evaluate the KAP of pharmacoepidemiology among paediatric pharmacists in Malaysia. The findings of this study will be of paramount importance in identifying the need for improvement of in-service training and areas where future research or intervention programmes should be focused on the use and application of pharmacoepidemiology data in providing safe and effective medicine for children.

MATERIALS AND METHODS

Operational definitions

According to the classification by the European Medicines Agency (EMEA) and the International Council for Harmonisation (ICH), paediatric patients were categorised by age, including neonates (below 28 days), infants (28 days to 23 months), children (2 to 11 years) and adolescents (12 to 18 years) (Ceci et al., 2002).

Paediatric pharmacists are clinical pharmacists working in various ward settings, including general paediatrics, paediatric intensive care, neonatal intensive care, and paediatric subspecialty wards, such as nephrology, neurology, dermatology, cardiology, and oncology. Their role is to optimise and influence the safe and effective use of medications for paediatric patients (Pharmaceutical Services Programme, 2015).

The definitions of KAP used in a previous study (Balan, 2021) were applied in this study.

Knowledge: Theoretical or practical understanding of the concept and application of pharmacoepidemiology.

Attitude: Predisposition to respond positively or negatively to pharmacoepidemiology approach and application.

Practice: Application of knowledge or practical approaches related to pharmacoepidemiology.

Ethical consideration

Ethical approval was obtained from the ethics committee for the Ministry of Health (MOH) facilities in Malaysia, i.e., the Medical Research and Ethics Committee (MREC) (NMRR ID-23-00214-2RW). The personal identifiers of respondents were not collected. Electronic informed consent was obtained from the respondents before the commencement of the study. The reporting of the study followed the consensus-based Checklist for Reporting Results of Internet E-Surveys (CHERRIES) (Eysenbach, 2004) (Supplementary material: Appendix A).

Study design

Cross-sectional, questionnaire-based study.

Study setting

Ministry of Health hospitals in Malaysia are generally classified as major, minor, or non-specialist hospitals and special medical institutions (regarded collectively as 'hospitals' hereinafter). Major and minor specialist hospitals differ by scope of specialty services and workload, whereas non-specialist hospitals provide visiting specialist services, and special medical institutions have specific resident specialties. In total, 146 MOH hospitals are in Malaysia (Health Informatics Center, 2022). As recommended by the Pharmaceutical Services Programme, the ratio of paediatric ward pharmacist to patient is 1:20 for general or sub-specialty wards and 1:10 for critical care wards (Pharmaceutical Services Programme, 2023). All hospitals with paediatric pharmacists were involved in this study.

Eligibility criteria

Paediatric pharmacists practicing in MOH hospitals with at least 12 months of clinical experience were included in the study. Paediatric pharmacists on leave (study leave, maternity leave etc.) during the study period and paediatric pharmacy trainees were excluded from the study.

Sampling technique and sample size

The convenience sampling technique was used in this study. The sample size was calculated using Raosoft online software available at "http://www.raosoft.com/samplesize.html". At the time of study conception, there were 149 paediatric pharmacists practising in MOH facilities in Malaysia. The sample size was calculated based on the assumption of a precision of 0.05 with a 95% confidence interval and response distribution of 50%. Based on this, the required number of respondents was 108.

Data collection

The data were collected using a validated, piloted, and self-administered online questionnaire. A closed survey approach was used whereby the email addresses of all paediatric pharmacists were obtained from the Pharmaceutical Services Programme, MOH. Invitations to participate, including the study brochure (Supplementary material: Appendix B), information sheet, and questionnaire link, were sent via email to all eligible paediatric pharmacists. Data were collected between April and June 2023. To increase participation and response rates, reminder emails were sent at one-month intervals. Respondents received no incentives because participation was voluntary. Consent to participate was obtained through the online questionnaire link. Paediatric pharmacists who agreed were directed to respond to the questionnaire, whereas those who declined were automatically redirected to exit the online questionnaire platform. The estimated time to complete the questionnaire was approximately 20 minutes. Respondents could review their responses through a 'Back' button, before submission.

Questionnaire development

A specific questionnaire was developed to assess KAP on pharmacoepidemiology and its application. The initial questions were formulated by the researcher based on the information gathered from a similar questionnaire (Norhayati & Nawi, 2021) and a thorough review of the literature (Barzkar, Baradaran, & Koohpayehzadeh, 2018; Lasky et al., 2016; S. Li, Cao, & Zhu, 2019; MacLeod, 2018; Osokogu, Verhamme, Sturkenboom, & Kaguelidou, 2018; Reali et al., 2021; Strom et al., 2013; Verhamme & Sturkenboom, 2011). The final wording of the questions was expressed as consensus in consultation with two academicians with expertise in paediatrics. The task undertaken in several sessions led to the first version of the questionnaire, which was subjected to face and content validation by a panel of experts, including former paediatric pharmacists, academicians, and pharmacoepidemiology specialists.

Former paediatric pharmacists identified through a snowballing method pilot-tested the final questionnaire draft. The usability and technical functionality of the electronic questionnaire were also included in the pilot testing. The final version of the questionnaire was refined based on the comments from the expert panel and feedback received during the pilot testing. The comments received during the pilot testing suggested adding definitions for the categories of duty (i.e., full-time and part-time) and including a time frame for questions related to conducting pharmacoepidemiology research and attending training.

The questionnaire was designed using Google Forms, and all questions were mandatory to respond. Key sections were presented in a logical order, but within sections, questions were randomised to reduce bias. The questionnaire consisted of five sections: Section 1 collected the sociodemographic data of the respondents, including age, gender, ethnicity, academic qualification, place of practice, years of experience, and information on training and research experience.

Section 2 assessed knowledge on pharmacoepidemiology using 16 items that encompassed an understanding of the concept (8 items) and application of pharmacoepidemiology (8 items). Responses were scored as 'Correct=1', 'Wrong=0,' and 'Unsure=0'.

Section 3 included 15 attitude items that were divided into three categories i.e. applicability (7 items), effect on practice (4 items), and learning (4 items); in keeping with previous studies (Barzkar et al., 2018; S. Li et al. (2019). Responses for attitude items were evaluated on a five-point Likert scale: Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2, and Strongly Disagree = 1.

Sections 4 contained 10 practice items which were assessed using a five-point Likert scale as follows: Always = 5, Often = 4, Sometimes = 3, Seldom = 2, Never = 1. The items within the practice section were categorised as either 'knowledge application' (3 items) or 'practical approach' (7 items) (Balan, 2021).

Section 5 contained nine facilitators of the pharmacoepidemiology approach and its application, which were identified from previous studies on practice-based research participation among hospital pharmacists (Reali et al., 2021) and challenges in paediatric pharmacoepidemiology (Osokogu et al., 2018). Responses to the items were evaluated on a five-point Likert scale: Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2, and Strongly Disagree = 1.

Data analysis

Response rate was calculated as the percentage of participants who submitted responses out of the total number of individuals invited to participate in the study. The total scores were calculated for each knowledge, attitude, and practice domain. Each total raw score was transformed into a "percent score" and categorised based on Bloom's cut-off point. In accordance with a previous KAP study (Zanaridah, Norhayati, & Rosnani, 2021), scores less than 59% denoted low, negative, and poor levels of knowledge, attitude, and practice. Scores within 60%–80% were equated with a moderate, neutral, and fair level of knowledge, attitude and practice. Scores exceeding 80% denote high, positive, and good levels of knowledge, attitude, and practice, respectively. Responses to facilitators of pharmacoepidemiology application are presented as raw scores. The pharmacoepidemiology attitudes and facilitators domains were categorised by grouping "strongly agree" and "agree" as positive responses and "disagree" and "strongly disagree" as negative responses. For the practice domain, 'always' and 'often' were categorised

as positive responses while 'seldom' and 'never' were categorised negative responses.

The data was entered and analysed using SPSS version 20. (IBM SPSS Statistics, IBM, New York, US). Descriptive analyses were conducted to define high levels of knowledge, positive attitudes, and a good practice of pharmacoepidemiology among paediatric pharmacist in Malaysia. Simple and multiple logistic regression analyses were performed to identify factors associated with pharmacoepidemiology practice.

A simple logistic regression analysis was performed to determine the potential associated factors for pharmacoepidemiology practice category. Independent variables that were statistically (p-value <0.25) and clinically significant were chosen for multivariate analysis using multiple logistic regression. The final variable selection was conducted using an automatic backward and forward stepwise procedure. Interactions and multicollinearity were checked. A model fit assessment was performed to obtain the final model. Crude and adjusted regression coefficients with 95% confidence intervals and p-values are presented. A $p < 0.05$ level was considered statistically significant.

RESULTS

Socio-demographic characteristics

A total of 149 paediatric pharmacists were invited to participate in the study, and 99 responded to the questionnaire (response rate of 66.44%). Most respondents (n=82, 82.83%) were practising in a single sub-discipline, while others practiced in multiple sub-disciplines (Table 1).

Knowledge of pharmacoepidemiology

High and moderate levels of knowledge were found in 22.22% and 53.54% of respondents, respectively. The average number of respondents with correct answers for items related to the application of pharmacoepidemiology (n=72) was higher than those related to the concept of pharmacoepidemiology (n=56). The knowledge items and corresponding responses are presented in Table 2.

Attitude towards pharmacoepidemiology

The responses to each attitude item are shown in Table 3. Overall, the majority (82.83%) of the respondents had a neutral attitude towards pharmacoepidemiology approach and its application. Items categorised as "effect" and "learning" received more positive responses compared to those categorised as "applicability". Specifically, up to 89.89% and 86.86% positive responses were recorded for items in the "effect" and "learning" categories, respectively. For items in the "applicability" category, positive responses reached up to 78.78%.

Practice of pharmacoepidemiology

None of the respondents had a good level of pharmacoepidemiology practice, with 58.59% and 41.41% reported to have poor and fair levels of pharmacoepidemiology practice, respectively. Positive responses for practice items related to the application of practical approaches (up to 43.43%) were slightly higher than those related to the application of knowledge (up to 26.26%) (Table 4). The responses for each practice items are shown in Table 4.

Facilitators of the pharmacoepidemiology approach and its application

On-the-job training (89.9%) and networking on paediatric pharmacy research (86.87%) were strongly recommended as key facilitators of pharmacoepidemiology. On the other hand, the least preferred facilitator (81.82%) was providing scheduled protected time for paediatric pharmacists to conduct pharmacoepidemiology research (Table 5).

Factors associated with pharmacoepidemiology practice

In the univariate analyses, ethnicity, workplace, category of duty, and knowledge and attitude scores were statistically significant and were subsequently included in the multivariate analysis. The overall fit of the model was checked and reported with Hosmer-Lemeshow test (p=0.768) and Pearson Chi-Square Test (p=4.904). The model explained 32.4% (Nagelkerke R2) of the variance in pharmacoepidemiology practice and correctly classified 73.7% of the cases. Multivariate logistic regression analyses demonstrated that knowledge and attitude scores were significantly associated with pharmacoepidemiology practice level among paediatric pharmacists (Table 6).

Table 1. Socio-demographic Characteristics of the Respondents (n = 99)

Variables	n (%)
Age (years ± SD)	34.3±3.99
Gender	
Female	86 (86.87)
Male	13 (13.13)
Ethnicity	
Malay	51 (51.52)
Chinese	40 (40.40)
Indian	7 (7.07)
Others	1 (1.01)
Highest academic qualification	
Degree	76 (76.77)
Masters	21 (21.21)
PhD	2 (2.02)
Current workplace	
Major Specialist Hospital	61 (61.62)
Minor Specialist Hospital	26 (26.26)
Non-specialist Hospital	11 (11.11)
Special Medical Institution	1 (1.01)
Working experience as paediatric pharmacist (years ± SD)	5.2±4.29
Category of duty	
Full-time	89 (89.9)
Part-time	10 (10.10)
Current sub-discipline	
General paediatrics	47 (47.47)
General paediatrics + NICU	3 (3.03)
General paediatrics + NICU + PICU + SCN	2 (2.02)
General paediatrics + NICU + SCN	6 (6.06)
General paediatrics + PICU	2 (2.02)
General paediatrics + SCN	1 (1.01)
NICU	20 (20.20)
NICU + PICU + SCN	1 (1.01)
NICU + SCN	2 (2.02)
PICU	10 (10.1)
SCN	1 (1.01)
Haemato-oncology	3 (3.03)
Paediatric surgery	1 (1.01)
Conducted pharmacoepidemiology research in the past 12 months	
Yes	1 (1.01)
No	95 (95.96)
Unsure	3 (3.03)
Attended training related to pharmacoepidemiology research methods	
Yes	0 (0)
No	97 (97.98)
Unsure	2 (2.02)

NICU=Neonatal Intensive Care Unit, PhD=Doctor of Philosophy, PICU=Paediatric Intensive Care Unit, SCN=Special care Nursery, SD=Standard Deviation.

Table 2. Knowledge Items with Percentage of Responses

Item (Category)	Description	Correct n (%)	Unsure n (%)	Wrong n (%)
K1 (Concept)	Pharmacoepidemiology is a bridge of science connecting both pharmacology and epidemiology.	96 (96.97)	3 (3.03)	-
K2 (Concept)	Pharmacoepidemiology research investigates the use of drug in the post marketing phase.	73 (73.74)	20 (20.2)	6 (6.06)
K3 (Concept)	Cohort, case-control and cross-sectional studies are examples of study designs used in pharmacoepidemiology.	70 (70.71)	24 (24.24)	5 (5.05)
K4 (Application)	Real-life clinical impact of a medication can be clearly demonstrated using pharmacoepidemiology approach.	87 (87.88)	10 (10.1)	2 (2.02)
K5 (Application)	Pharmacoepidemiology approach can be used to identify and evaluate causes or risk factors of diseases.	78 (78.79)	11 (11.11)	10 (10.1)
K6 (Concept)	Prospective studies are less prone to bias and can more easily demonstrate causation.	71 (71.72)	21 (21.21)	7 (7.07)
K7 (Concept)	Meta-analysis is superior to case-control studies in evidence-based medicine.	76 (76.77)	16 (16.16)	7 (7.07)
K8 (Application)	Pharmacoepidemiology approach can be used in tool development to evaluate rational drug use.	88 (88.89)	9 (9.09)	2 (2.02)
K9 (Concept)	Pharmacoepidemiology studies utilise both observational and experimental methods.	9 (9.09)	23 (23.23)	66 (67.68)
K10 (Application)	Pharmacoepidemiology study findings is suitable for making decisions about patient care rather than for policy making.	20 (20.2)	24 (24.24)	55 (55.56)
K11 (Application)	Pharmacoepidemiology approach can be used in supporting the rational and cost-effective use of drugs in the population.	93 (93.94)	3 (3.03)	3 (3.03)
K12 (Application)	In clinical settings, pharmacoepidemiology studies can be used for hypothesis generating and testing.	71 (71.72)	21 (21.21)	7 (7.07)
K13 (Application)	Drug utilisation studies in children may be used to identify the major therapeutic problems in this population.	84 (84.85)	13 (13.13)	2 (2.02)
K14 (Application)	The study of adverse drug reactions (ADRs) in a pharmacovigilance database is a type of pharmacoepidemiology study.	79 (79.8)	18 (18.18)	2 (2.02)
K15 (Concept)	The STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) checklist is an instrument to evaluate the quality of observational research.	3 (3.03)	50 (50.51)	46 (46.46)
K16 (Concept)	The measure of risk that is calculated in case-control studies is the odds ratio, which are the odds of having the exposure if an individual has the disease.	56 (56.57)	37 (37.37)	6 (6.06)

DISCUSSION

Approximately 20% of the respondents reported having good knowledge about pharmacoepidemiology. Considering the educational background and working experience, we inferred that the participants' knowledge of pharmacoepidemiology was acquired during their undergraduate years. The observed low level of knowledge underscores the previously identified disparities between the curriculum (Herrera Comoglio, 2020) and the impact (M. Li, Schulz, Wang, & Lu, 2019) of pharmacoepidemiology in both undergraduate and postgraduate programmes at universities. Although refinement of university curricula is important, these findings also highlighted the necessity of discovering methods to enhance the preparedness of paediatric pharmacists with the requisite knowledge and skills in pharmacoepidemiology. A collaborative approach involving educational institutions and practicing professionals to ensure a comprehensive understanding of pharmacoepidemiology will foster a more proficient and well-equipped workforce in the field.

The overall attitude of paediatric pharmacists towards pharmacoepidemiology was neutral. Although majority of the respondents expressed that pharmacoepidemiology can yield favourable effects on their practice, lower scores were given regarding its applicability. Similar findings were reported by another local study, in which pharmacists gave lower scores for the attitude domain, namely, implementing research into practice' compared to other domains (Tan & Hatah, 2017). While performing their duties, pharmacists typically rely more on formularies and drug information sources rather than evidence from research articles (Iheanacho, Odili, & Oluigbo, 2021). Furthermore, prescribers tend to have greater discretion in medical decision-making, although a multidisciplinary approach is advocated (Coughlin, 2018). These circumstances may have led pharmacists to perceive the implementation of pharmacoepidemiological evidence as challenging.

Table 3. Attitude Items with Percentage of Responses

Item (Category)	Description	Strongly agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly disagree n (%)
A1 (Effect)	I believe practicing pharmacoepidemiology approach improves patient health outcome	57 (57.58)	32 (32.32)	10 (10.1)	-	-
A2 (Learning)	I am willing to learn about pharmacoepidemiology approach and application if given the opportunity	51 (51.52)	35 (35.35)	10 (10.1)	3 (3.03)	-
A3 (Effect)	I believe that pharmacoepidemiology approach and application is a threat to good clinical practice	31 (31.31)	19 (19.19)	12 (12.12)	26 (26.26)	11 (11.11)
A4 (Applicability)	I am ready to practice pharmacoepidemiology approach and application in my work	34 (34.34)	41 (41.41)	21 (21.21)	3 (3.03)	-
A5 (Applicability)	I feel that pharmacoepidemiology research findings are very important in my day-to-day management of patients	38 (38.38)	40 (40.4)	20 (20.2)	1 (1.01)	-
A6 (Applicability)	I feel that pharmacoepidemiology approach and application is of limited value in paediatric medicine	20 (20.2)	23 (23.23)	20 (20.2)	26 (26.26)	10 (10.1)
A7 (Applicability)	I believe that years of clinical experience is more valuable than evidence derived from pharmacoepidemiology studies	19 (19.19)	15 (15.15)	32 (32.32)	27 (27.27)	6 (6.06)
A8 (Effect)	I am convinced that pharmacoepidemiology approach and application in clinical practice increases the effectiveness of my work	36 (36.36)	45 (45.45)	17 (17.17)	1 (1.01)	-
A9 (Applicability)	I feel confident managing patients with evidence derived from pharmacoepidemiology studies	36 (36.36)	41 (41.41)	20 (20.2)	1 (1.01)	1 (1.01)
A10 (Applicability)	I believe that understanding the basic drug effect and outcome is sufficient for good clinical practice	27 (27.27)	24 (24.24)	23 (23.23)	20 (20.2)	5 (5.05)
A11 (Effect)	I feel that practicing pharmacoepidemiology approach and application would produce better health practitioners	42 (42.42)	43 (43.43)	12 (12.12)	2 (2.02)	-
A12 (Applicability)	I often feel burdened whenever needing to use pharmacoepidemiology approach in practice	8 (8.08)	20 (20.2)	47 (47.47)	20 (20.2)	4 (4.04)
A13 (Learning)	I am happy if it is mandatory for paediatric pharmacists to learn about pharmacoepidemiology	18 (18.18)	32 (32.32)	41 (41.41)	6 (6.06)	2 (2.02)
A14 (Learning)	I think that continuous education and incorporating formal teaching of pharmacoepidemiology approach and application is very important	38 (38.38)	45 (45.45)	13 (13.13)	3 (3.03)	-
A15 (Learning)	I am willing to attend training programmes specifically dedicated to paediatric pharmacoepidemiology	44 (44.44)	39 (39.39)	14 (14.14)	2 (2.02)	-

Table 4. Practice Items with Percentage of Responses

Item (Category)	Description	Always n (%)	Often n (%)	Sometimes n (%)	Seldom n (%)	Never n (%)
P1 (Knowledge application)	I use pharmacoepidemiology approach and application in my daily practice	4 (4.04)	20 (20.2)	41 (41.41)	19 (19.19)	15 (15.15)
P2 (Practical approach)	I use multiple search engines to look for pharmacoepidemiology study articles	10 (10.1)	24 (24.24)	33 (33.33)	19 (19.19)	13 (13.13)
P3 (Practical approach)	I search for pharmacoepidemiology articles from published journal only	3 (3.03)	28 (28.28)	37 (37.37)	18 (18.18)	13 (13.13)
P4 (Practical approach)	I do not have enough time to study on pharmacoepidemiology approach and application	18 (18.18)	35 (35.35)	33 (33.33)	9 (9.09)	4 (4.04)
P5 (Knowledge application)	I do not apply pharmacoepidemiology approach in my professional duties due to limitations of the management that I can offer to paediatric patients	10 (10.1)	23 (23.23)	41 (41.41)	18 (18.18)	7 (7.07)
P6 (Knowledge application)	I use pharmacoepidemiology approach and application for answering the questions in clinical setting	7 (7.07)	19 (19.19)	48 (48.48)	14 (14.14)	11 (11.11)
P7 (Practical approach)	I join continuous medical education for updates regarding pharmacoepidemiology approach and application	4 (4.04)	18 (18.18)	24 (24.24)	30 (30.3)	23 (23.23)
P8 (Practical approach)	I share knowledge on pharmacoepidemiology approach and application with my colleagues	1 (1.01)	13 (13.13)	27 (27.27)	32 (32.32)	26 (26.26)
P9 (Practical approach)	I promote pharmacoepidemiology approach and application to my colleagues at workplace	2 (2.02)	13 (13.13)	26 (26.26)	26 (26.26)	32 (32.32)
P10 (Practical approach)	I do not need to conduct pharmacoepidemiology research as evidence is available about many interventions I make in my clinical practice	6 (6.06)	13 (13.13)	37 (37.37)	26 (26.26)	17 (17.17)

Table 5. Facilitators of Pharmacoepidemiology with Percentage of Responses

Item	Description	Strongly agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly disagree n (%)
S1	Inclusion of pharmacoepidemiology approach and application in decision making process	25 (25.25)	58 (58.58)	15 (15.15)	1 (1.01)	-
S2	Provide opportunities and assistance to increase publication of pharmacoepidemiology study(s) in peer-reviewed journals	28 (28.28)	55 (55.55)	16 (16.16)	-	-
S3	Provide opportunities and assistance to present pharmacoepidemiology study(s) in local and international conferences.	28 (28.28)	55 (55.55)	15 (15.15)	1 (1.01)	-
S4	Easy accessibility to pharmacoepidemiology outcome data and research articles/reports	42 (42.42)	42 (42.42)	13 (13.13)	1 (1.01)	1 (1.01)
S5	Establishing a network of paediatric pharmacists' research group to discuss pharmacoepidemiology outcome data and research articles/reports	44 (44.44)	42 (42.42)	13 (13.13)	-	-
S6	Regular e-mail update on recent pharmacoepidemiology outcome data and research articles/reports involving paediatric patients	38 (38.38)	44 (44.44)	14 (14.14)	3 (3.03)	-
S7	Providing adequate on-the-job training in conducting pharmacoepidemiology studies	41 (41.41)	48 (48.48)	9 (9.09)	1 (1.01)	-
S8	Providing incentive for paediatric pharmacists who conduct and publish/present pharmacoepidemiology studies	46 (46.46)	38 (38.38)	15 (15.15)	-	-
S9	Providing scheduled protected time for paediatric pharmacists to conduct pharmacoepidemiology study(s)	40 (40.4)	41 (41.41)	16 (16.16)	2 (2.02)	-

Table 6. Factors associated with pharmacoepidemiology practice

Factors	Practice category		b	Adjusted OR (95% CI)	p-value
	Fair, n=41	Poor, n=58			
Knowledge score, % (SD)	73.2 (11.6)	61.9 (17.4)	0.064	1.067 (1.023, 1.112)	0.02
Attitude score, % (SD)	77.5 (8.7)	71.3 (6.9)	0.112	1.118 (1.044, 1.198)	0.02

Poor pharmacoepidemiology practice was observed among paediatric pharmacists, reinforcing the notion that translating research into actionable outcomes is a common challenge within the profession. Additionally, knowledge and attitude scores were associated with pharmacoepidemiology practice among paediatric pharmacists. Emphasising theoretical knowledge is crucial in the approach and application of pharmacoepidemiology, considering the numerous challenges unique to the field (Beyene, Chan, & Man, 2023), particularly those specific to paediatric pharmacoepidemiology (Osokogu et al., 2018). By addressing knowledge and attitude factors, there is a potential to enhance the overall competence and practice of paediatric pharmacists in pharmacoepidemiology, ultimately leading to improved patient care and outcomes in the field.

Paediatric pharmacists strongly recommended on-the-job training and the establishment of a research group network as facilitators of pharmacoepidemiology. These findings align with the mission statement and objectives of the Paediatric Special Interest Group (SIG) of the International Society for Pharmacoepidemiology (ISPE) (Pharmacoepidemiology, n. d.). The feasibility of designing and implementing a pharmacy-tailored research training programme has been shown to positively impact pharmacists' knowledge and attitudes (Awaisu et al., 2015). Locally, a research technical committee for pharmacoepidemiology and data analysis, along with a paediatric pharmacists' working group committee, exists within the Pharmaceutical Services Programme. Close collaboration between these entities could foster the development and implementation of a training programme to equip paediatric pharmacists with the necessary skills and knowledge for effective pharmacoepidemiology practice.

The proposed training module development process can be divided into three phases. In Phase I, the educational and training needs of paediatric pharmacists can be evaluated. The questionnaire used in this study is easily adaptable for this purpose. Phase II includes the design and delivery of training. The active-learning method i.e. learning-centred paradigm, can be considered as it has been proven successful in providing on-the-job training for practicing pharmacists (Peletidi & Kayyali, 2022). As observed in the current study, knowledge of the concept of pharmacoepidemiology could be emphasised in the training module. As poor practice of pharmacoepidemiology was observed, the training module should also consist of hands-on research discussions and group assignments to conduct pharmacoepidemiology studies. The research topics can be predetermined based on professional or national research priorities. Finally, in Phase III, the evaluation of the training programme can be conducted to assess its effectiveness and identify aspects that can be improved.

To the best of our knowledge, this is the first study, both in local and global contexts, to assess the KAP of paediatric pharmacists in the pharmacoepidemiology field. The items included in the main domains of the questionnaire incorporated the element of applicability, emphasising the practical relevance of the gathered information. Nevertheless, this study has some limitations. The study used a self-reporting questionnaire, which may have been subject to response bias. However, efforts were made to minimise response bias by ensuring participant anonymity and confidentiality. The study items excluded open-ended questions that were deemed appropriate for focusing on the breadth rather than the depth of the information. The generalisability of the findings beyond the Malaysian context may be limited. However, considering the richness of the information presented, the study is easily replicable in other settings. This can potentially lead to the customisability of the proposed training module development process to specific contexts. Future studies could use a qualitative study design to explore in-depth information regarding pharmacoepidemiology facilitators, barriers, and application strategies among paediatric pharmacists. Findings of the qualitative study can be considered in Phase I of the proposed training module development process.

CONCLUSION

Paediatric pharmacists demonstrated moderate knowledge and a neutral attitude, but poor practice towards pharmacoepidemiology. Future initiatives should emphasise collaborative efforts between academic institutions, professional bodies and practitioners to address the knowledge and attitude of paediatric pharmacists. This can be achieved through the development of a training module and the provision of on-the-job training to enhance the pharmacoepidemiology approach and application among paediatric pharmacists in Malaysia.

Ethics Committee Approval: Ethical approval was obtained from the ethics committee for the Ministry of Health (MOH) facilities in Malaysia, i.e., the Medical Research and Ethics Committee (MREC) (NMRR ID-23-00214-2RW)

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