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- Quality of life assessment in adolescents with rheumatological diseases
- Bullying and emotional-mental disorders among adolescents
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Original Article

Bridging the breastfeeding knowledge gap: effectiveness of the *Indonesian Breastfeeding Course for Clinicians* (IBFCC) 2022-2025

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Abstract

Background Physician competency in breastfeeding counseling is crucial for improving suboptimal breastfeeding rates in Indonesia, where exclusive breastfeeding coverage (67.96% in 2023) remains below the national target of 80%. The Indonesian Breastfeeding Course for Clinicians (IBFCC) is a structured continuing medical education (CME) program developed by Satuan Tugas Air Susu Ibu Ikatan Dokter Anak Indonesia/Satgas ASI-IDAI (Breastfeeding Task Force of the Indonesian Pediatrics Society/IPS), yet its effectiveness has not been formally evaluated.

Objective To evaluate the effectiveness of the IBFCC in improving physician breastfeeding knowledge across multiple centers and to characterize factors associated with knowledge improvement.

Methods A multicenter, single-group, paired pre-post intervention study was conducted between 2022 and 2025 across 17 batches delivered at 13 training sites, comprising 11 IPS regional branches in 11 Indonesian provinces and 2 hospital-based sites in Jakarta. Knowledge was assessed using a 15-item validated questionnaire administered immediately before and after training. The Wilcoxon signed-rank test served
as the primary analysis, with a paired t-test reported for comparability. Effect sizes were expressed as Cohen's d and Wilcoxon r. Passing rates (≥60%) were compared using the McNemar test. Factors significantly associated with knowledge improvement was age.

Results Of 1,176 enrollees, 1,106 (94.0%) with complete paired data constituted the analytic sample. The mean pre-test score was 40.2 (SD 11.0)% and the mean post-test score was 71.0 (SD 12.5)%, a mean improvement of 30.8 percentage points (95%CI 29.9 to 31.7; paired t-test t=66.99, df=1,105, P<0.001; Wilcoxon signed-rank Z=28.40, P<0.001). The effect size was very large (Cohen's d=2.01; 95%CI 1.91 to 2.12; Wilcoxon r=0.85) and the mean normalised gain was 0.50 (SD 0.22). The largest item-level gains were for tongue-tie-related nipple pain (+90.2%), early initiation of breastfeeding (+73.7%) and signs of effective latch and milk transfer (+69.3%); three items did not improve. Improvement did not differ between pediatricians and general physicians (30.9 vs. 30.1 percentage points; P=0.39), but increased with age group, from 20.0 percentage points in participants aged ≤35 years to 38.4 in those aged >55 years (P<0.001).

Conclusion The IBFCC produces substantial improvements in physician breastfeeding knowledge that are consistent across professional affiliations. Smaller gains among younger physicians indicate a need for targeted reinforcement and monitoring of delivery fidelity. These findings support nationwide scale-up as a mandated CME program for physicians involved in maternal and child health. **[Paediatr Indones. 2026;66:338-48; DOI: https://doi.org/10.14238/pi66.4.2026.338-48**].

Keywords: *breastfeeding counselling; continuing medical education; knowledge improvement; physician*

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Breastfeeding is one of the most effective and cost-efficient preventive health interventions. *The World Health Organization* (WHO) and UNICEF recommend exclusive breastfeeding for the first six months of life, and continued alongside complementary foods for two years or beyond.[1,2] Systematic evidence indicates that optimal breastfeeding practices could prevent approximately 823,000 child deaths and 20,000 maternal deaths annually worldwide.[3] For infants, breastfeeding reduces the risks of diarrhea, respiratory illness, otitis media, sudden infant death syndrome, obesity, and childhood leukemia.[3] For mothers, it confers protection against type 2 diabetes, hypertension, as well as breast and ovarian cancers.[4] These benefits are particularly salient in low- and middle-income countries (LMICs), where age-standardized disability-adjusted life years (DALYs) attributable to suboptimal breastfeeding are estimated at 295.1 per 100,000 population - more than 50 times higher than in high sociodemographic index countries.[5]

In Indonesia, exclusive breastfeeding coverage among infants under six months was 67.96% in 2023, having improved from 52% in 2017.[6] Despite this progress, the rate remains below the Ministry of Health's national target of 80% and below the WHO global target of 70% for 2025.[7] Globally, only 48% of infants under six months are exclusively breastfed as of the *2023 Global Breastfeeding Scorecard*, an indication of the universal scale of this public health challenge.[8] Provincial rates exhibit substantial heterogeneity, ranging from below 40% in parts of Kalimantan to above 75% in Java.6 Indonesia's substantial burden of approximately 700,000 preterm births annually further amplifies the need for physician competency in lactation support for vulnerable neonates.[9]

Physicians occupy a uniquely influential position in breastfeeding support. Physician recommendation is among the strongest predictors of breastfeeding initiation and continuation, with healthcare provider endorsement identified as a key determinant in multiple large-scale survey.[10,11] However, critical gaps in physician breastfeeding knowledge and skills have been extensively documented. A cross-sectional study across 26 United Kingdom medical schools found that only 3% of final-year medical students felt confident assisting with infant latching, and only those with formal clinical training showed improved practical skills.[12] *The Academy of Breastfeeding Medicine* (ABM) specifies that all physicians should possess core breastfeeding competencies, yet residency programs consistently fail to provide adequate training.[13,14] These deficits are not unique to Western contexts; studies in South-East Asia and other LMICs report comparable knowledge gaps among physicians and medical students.[15]

Continuing medical education (CME) programs represent the primary pathway for addressing these knowledge and competency deficits in practicing physicians. A systematic review and meta-analysis conducted by the *United States Preventive Services Task Force* (USPSTF) of primary care-based breastfeeding education reported a pooled mean improvement of 23 percentage points in breastfeeding initiation rates, with the largest effects observed in populations with low baseline knowledge.[16] Structured breastfeeding training programs have been shown to improve healthcare professionals' self-efficacy, practical skills, and clinical behaviors, therefore support increases both any and exclusive breastfeeding to six months.[17-19] A comprehensive systematic review of 30 studies concluded that breastfeeding skills training for health care professionals consistently improved knowledge and attitudes, though the heterogeneity in study designs and outcome measures limited meta-analytic synthesis.[20] More recently, a 2025 evaluation of an interdisciplinary professional graduate program in breastfeeding and lactation demonstrated significant improvements in knowledge, attitudes, and practices among healthcare professionals using a pre-post design.[21] These findings support the theoretical framework of adult learning theory (andragogy), which posits that professionals learn most effectively through structured, clinically relevant, and experientially grounded educational programs.[22]

The Indonesian Breastfeeding Course for Clinicians (IBFCC) was developed by the *Satuan Tugas Air Susu Ibu Ikatan Dokter Anak Indonesia/Satgas ASI-IDAI* (*Breastfeeding Task Force of the Indonesian Pediatrics Society*) as a comprehensive nine-module CME program designed to address the full scope of ABM-recommended physician breastfeeding competencies.[13] Since its inception, the IBFCC has been delivered across multiple provinces and professional organizations, yet its educational

effectiveness has not been formally evaluated. Thus, we aimed to evaluate the effectiveness of the IBFCC in improving physician breastfeeding knowledge across multiple centers, and to characterize factors associated with knowledge improvement including professional background, age, and geographical region.

Methods

A multicenter, single-group, paired pre-post intervention study was conducted. This study design has been established as the standard for CME evaluation where randomized control groups are ethically and logistically infeasible, corresponding to Kirkpatrick's Level 2 (learning) evaluation framework.[23,24] Training was delivered in 17 sequential batches between 2022 and 2025 across 13 training sites in IPS regional branches: Banten, East Java, West Java, DKI Jakarta, East Kalimantan, Central Java, North Sulawesi, West Sumatra, West Kalimantan, West Nusa Tenggara, and Jambi, as well as at two hospital-based sites in Jakarta: *Rumah Sakit Pusat Angkatan Darat Gatot Soebroto/RSPAD* (Gatot Soebroto Army Central Hospital) and Tzu Chi Hospital (TCH).

All licensed physicians attending an IBFCC training session were eligible. Inclusion criteria were: 1) licensed physician registered with *Ikatan Dokter Anak Indonesia/Indonesian Pediatrics Society* (IDAI/IPS), *Ikatan Dokter Indonesia/Indonesian Medical Association* (IDI/IMA), or an affiliated professional affiliation; 2) completion of both pre-test and post-test; and 3) attendance at the full program. Incomplete questionnaires were excluded from paired analyses.

The IBFCC is a structured, facilitator-led CME program comprising nine modules: 1) Lactation Physiology; 2) Prenatal Preparation and Early Initiation of Breastfeeding; 3) Postnatal Support 0-72 Hours and Baby-Friendly Hospital Initiative; 4) Breastfeeding Problems in Mothers; 5) Breastfeeding Problems in Infants; 6) Growth Assessment in Breastfed Infants; 7) Breastfeeding Support for Premature and Sick Infants; 8) Human Milk Storage and Pasteurization; and 9) Communication and Counseling Skills. The program was delivered in a one- to two-day intensive format by IDAI-certified facilitators using standardized materials, interactive case-based discussions, and practical demonstrations. The curriculum was designed to align with ABM educational objectives for physician breastfeeding competencies.[13]

Knowledge was assessed using a validated 15-item multiple-choice questionnaire administered immediately before (pre-test) and immediately after (post-test) the training. Each item was scored dichotomously (correct = 1, incorrect = 0), yielding a raw score of 0-15, subsequently converted to a percentage score (0-100%). The items spanned all nine modules and addressed lactogenesis physiology, changes in breast milk composition, early initiation of breastfeeding (IMD), increasing milk supply, causes of early postpartum nipple pain, infant positioning, signs of effective latch and milk transfer, tongue-tie-related nipple pain, neonatal weight loss, growth parameters in exclusively breastfed infants, interpretation of infant weight gain, feeding route for preterm infants, effects of human milk storage and pasteurization, counseling communication, and building maternal confidence (self-efficacy). The passing threshold was set at ≥60% (9/15 correct), consistent with standard CME assessment benchmarks.[25]

Continuous variables were expressed as mean (standard deviation/SD) when normally distributed and as median with interquartile range (IQR) when not; categorical variables were expressed as frequencies and percentages. Normality was assessed using the Shapiro-Wilk test. Age was not normally distributed (Shapiro-Wilk $P<0.001$) and is therefore presented as median (IQR); it was also categorized into four groups (≤35, 36-45, 46-55 and >55 years) for subgroup analyses. Given the non-normal distribution of pre-post difference scores (Shapiro-Wilk $P<0.001$), Wilcoxon signed-rank test served as the primary analysis. The paired t-test was additionally reported for comparability with the existing literature, as it remains robust with large sample sizes under the central limit theorem.[26]

Effect sizes were expressed as Cohen's d, calculated as the mean difference divided by the standard deviation of the differences ($d=Mdiff/SDdiff$).[27] Cohen's d was interpreted using conventional benchmarks: small (0.2), medium (0.5), large (0.8), and very large (≥1.2). The Wilcoxon effect size r was computed as $|Z|/\sqrt{N}$. The normalised gain (N-Gain) was additionally computed as (post-test - pretest)/

(100 - pretest) to quantify the proportion of maximum achievable improvement attained. The McNemar test compared pre- and post-test passing rates (threshold ≥60%). The association between pre-test and post-test scores was assessed using Spearman's rank correlation.

To characterize factors associated with knowledge improvement, the change in score (post-test minus pre-test, in percentage points) was compared across professional affiliation (IPS, IMA, others) and age group using the Kruskal-Wallis test, with the Mann-Whitney U test for the comparison between pediatricians and general physicians. A multivariable linear regression model was then fitted with the change in score as the dependent variable and professional affiliation, age group, and pre-test score as independent variables; inclusion of the pre-test score adjusts for regression to the mean and ceiling effects. Results are presented as regression coefficients (β) with 95%CI. Significance was set at $P<0.05$ (two-tailed). Analyses were performed using *SPSS version 26.0* software.

The study was approved by *Health Research Ethics Committee - National Institute of Health Research and Development* (HREC-NIHR), covered for all training sites because the IBFCC is one national programme delivered under the IPS Breastfeeding Task Force.

Results

A total of 1,176 physicians enrolled in the IBFCC across 17 batches. Of these, 1,106 (94.0%) had complete paired pre- and post-test data and constituted the analytic sample for paired analyses. Those 70 (6.0%) with incomplete test pairs were excluded. Descriptive statistics for the analytic sample (N=1,106) are presented in **Table 1**. Age was not normally distributed (Shapiro-Wilk $P<0.001$); the median age was 48 years (IQR 44-52; range 32-66). By professional affiliation, the majority were 878 (79.4%) pediatricians registered with IPS, followed by 217 (19.6%) general physicians registered with IMA and 11 (1.0%) belonged to other health professional organisations (**Table 1**). By age group, the largest subgroup was 46–55 years (624; 56.4%), followed by 36-45 years (377; 34.1%), >55 years (88; 8.0%) and ≤35 years (17; 1.5%). Participants were drawn from 13 training sites, with Banten contributing the largest proportion (180; 16.3%), followed by East Java (147; 13.3%), West Java (142; 12.8%) and DKI Jakarta (134; 12.1%).

The primary outcome results are summarized in **Table 2**. The mean pre-test score was 40.2 (SD 11.0)% (median 40.0%, IQR 33-47) and the mean post-test score was 71.0 (SD 12.5)% (median 73.3%, IQR 67-80), a mean improvement of 30.8 percentage points (95%CI 29.9 to 31.7; SD of the differences 15.3). The improvement was significant on the primary Wilcoxon signed-rank test ($Z=28.40$; $P<0.001$), and the paired t-test was concordant ($t=66.99$; $df=1,105$; $P<0.001$).

The effect size was very large: Cohen's $d=2.01$ (95%CI 1.91 to 2.12), well above the conventional threshold for a very large effect (≥1.2), and the Wilcoxon effect size $r=0.85$ ($r\geq0.5$ is conventionally large). The mean normalised gain was 0.50 (SD 0.22), indicating that on average participants closed half of the gap between their baseline score and a perfect score. Improvement was not universal: 1,065

Table 1. Participants' characteristics

Characteristics	(N=1,106)
Professional affiliation, n(%)	
IPS (pediatricians)	878 (79.4)
IMA (general physicians)	216 (19.5)
Others (obstetrics, dentists, etc)	12 (1.1)
Age group, n(%)	
≤35 years	17 (1.5)
36-45 years	377 (34.1)
46-55 years	624 (56.4)
>55 years	88 (8.0)
Mean (SD)	47.9 (5.8)
Median (range)	48 (26-66)
Training site, n(%)	
Banten	180 (16.3)
East Java	147 (13.3)
West Java	142 (12.8)
DKI Jakarta	134 (12.1)
East Kalimantan	79 (7.1)
Central Java	71 (6.4)
North Sulawesi	68 (6.1)
West Sumatra	62 (5.6)
West Kalimantan	54 (4.9)
RSPAD Gatot Soebroto	48 (4.3)
West Nusa Tenggara	41(3.7)
Jambi	40 (3.6)
Tzu Chi Hospital	40 (3.6)

IPS=*Indonesian Pediatric Society (Ikatan Dokter Anak Indonesia*, IDAI); IMA=*Indonesian Medical Association (Ikatan Dokter Indonesia*, IDI); Others=members of other health professional organisations (obstetrics and gynaecology, dentistry, nursing) and residents; IQR=interquartile range; RSPAD=*Rumah Sakit Pusat Angkatan Darat (Gatot Soebroto Army Central Hospital*).

participants (96.3%) improved, 19 (1.7%) were unchanged and 22 (2.0%) scored lower after training.

The passing rate (≥60%) increased dramatically from 6.0% (66/1,106) before training to 89.2% (986/1,106) after training (McNemar $\chi^2=906.2$; $P<0.001$). Of the 1,040 participants who failed the pre-test, 926 passed the post-test, while 6 of the 66 who had passed the pre-test did not pass the post-test. Before training, 1 physician in 17 met the minimum competency threshold; afterwards, roughly 9 in 10 did. This 83.2 percentage-point increase in the passing rate represents a clinically meaningful transformation. Whereas fewer than 1 in 20 physicians met the minimum competency threshold before training, nearly 9 in 10 achieved it after the IBFCC.

Pre-test and post-test scores were weakly correlated (Spearman's $\rho=0.084$; $P=0.005$), whereas the change in score was inversely correlated with the pre-test score ($\rho=-0.58$; $P<0.001$).

Item-level results (**Table 3**) revealed marked heterogeneity in both baseline knowledge and magnitude of improvement across the 15 items. The largest gain was for tongue-tie-related nipple pain (item 8: 3.1% to 93.3%; $\Delta=+90.2\%$), which had the lowest baseline accuracy of any item. Other items gaining more than 60% were early initiation of breastfeeding (item 3: 13.5% to 87.2%; $\Delta=+73.7\%$) and signs of effective latch and milk transfer (item 7: 18.8% to 88.1%; $\Delta=+69.3\%$). Gains of 40-60% were seen for lactogenesis physiology (item

Table 2. Primary pre-post outcomes (N=1,106)

Parameters	Pre-test	Post-test	Δ	Effect size	P value
Mean score (SD), %	40.2 (11.0)	71.0 (12.5)	+30.8	d=2.01	<0.001*
Median score (IQR), %	40.0 (33–47)	73.3 (67–80)	+33.3	r=0.85	<0.001†
Mean raw score /15 (SD)	6.03 (1.66)	10.66 (1.88)	+4.63	-	<0.001*
Mean passing rate ≥60%(SD)	66 (6.0)	986 (89.2)	+83.2	-	<0.001‡
Mean N-Gain (SD)	-	-	0.50 (0.22)	-	-

IQR=interquartile range; *Paired T-test (t=66.99, df=1,105); †Wilcoxon signed-rank test (W=1,876.5, Z=28.40); ‡McNemar test ($\chi^2=906.2$; 926 participants moved from fail to pass and 6 from pass to fail); 95%CI of the mean improvement 29.9 to 31.7; 95%CI of Cohen's d 1.91 to 2.12; Cohen's d: small=0.2, medium=0.5, large=0.8, very large ≥.2.

Table 3. Item-level knowledge accuracy: pretest and post-test (N=1,106)

Item	Knowledge domain	Pre %	Post %	Δ %	Interpretation
1	Lactogenesis physiology	16.4	75.2	+58.9	Large gain
2	Breast milk composition	19.0	45.2	+26.2	Moderate gain
3	Early initiation	91.0	95.9	+5.0	Ceiling effect
4	Insufficient milk supply	13.5	87.2	+73.7	Very large gain
5	Positioning and latch-on	85.2	93.9	+8.8	Ceiling effect
6	Expressed breast milk	25.4	80.6	+55.2	Large gain
7	Sore nipple	18.8	88.1	+69.3	Very large gain
8	Oro-motoric assessment	3.1	93.3	+90.2	Very large gain
9	Infant weight loss	69.3	67.9	-1.4	Stable*
10	Growth assessment	64.9	91.1	+26.2	Moderate gain
11	Identifying BF challenges	26.8	83.4	+56.6	Large gain
12	Premature infants	58.5	70.1	+11.6	Moderate gain
13	Human milk donor	40.1	17.6	-22.5	Decline*
14	Counselling communication	10.0	30.0	+20.0	Moderate gain
15	BF self-efficacy	61.5	46.0	-15.5	Decline*

Pre- and post- are the percentages of the analytic sample answering the item correctly; Δ is the absolute difference between them. Very large gain >60%; large gain 40-60%; moderate gain 10-40%; ceiling effect indicates baseline accuracy already above 80%. *Item flagged for psychometric review (formal item analysis of difficulty, discrimination and distractor performance).

1: Δ=+58.9%), interpretation of infant weight gain (item 11: Δ=+56.6%) and infant positioning (item 6: Δ=+55.2%). The two items with the highest baseline accuracy, increasing milk supply (item 4: 91.0%) and causes of early nipple pain (item 5: 85.2%), showed the smallest positive gains (Δ=+5.0% and +8.8%, respectively).

Three items did not follow this pattern. Item 9 (neonatal weight loss) was essentially unchanged (69.3% to 67.9%; Δ=-1.4%). Item 13 (human milk storage and pasteurization) fell from 40.1% to 17.6% (Δ=-22.5%) and item 15 (building maternal confidence) fell from 61.5% to 46.0% (Δ=-15.5%). These three items are flagged in **Table 3** for psychometric review, that is, for formal statistical examination of how each item behaves as a measurement instrument, its difficulty, its ability to discriminate between more and less knowledgeable candidates, and the performance of its distractor options using classical test theory or item response theory.

Factors associated with knowledge improvement are presented in **Table 4**. The increase in score did not differ significantly by professional affiliation (Kruskal-Wallis P=0.55); pediatricians and general physicians improved by 30.9 (SD 15.2) and 30.1 (SD 15.9) percentage points, respectively (Mann-Whitney P=0.39; Cohen's d 2.04 and 1.89), with post-test passing rates of 89.5% and 87.1%. In contrast, improvement increased progressively with age group, from 20.0 (SD 14.5) percentage points in participants aged ≤35 years to 26.1 (SD 14.6), 32.9 (SD 14.9) and 38.4 (SD 14.9) percentage points in those aged 36-45, 46-55 and >55 years, respectively (P<0.001), and the post-test passing rate rose correspondingly from 17.6% to 98.9%.

In the multivariable linear regression model (adjusted R^2=0.72), age group remained independently associated with the change in score after adjustment for professional affiliation and pre-test score. Compared with participants aged 46-55 years, those aged ≤35 and 36-45 years gained 25.0 (95%CI 20.9 to 29.0) and 8.4 (95%CI 7.2 to 9.5) percentage points less, and those aged >55 years gained 10.7 (95%CI 8.8 to 12.5) percentage points more (all P<0.001). After adjustment, general physicians gained marginally more than pediatricians (β=2.4; 95%CI 1.0 to 3.7; P=0.001). Each 1-percentage-point higher pre-test score was associated with a 1.1-percentage-point smaller gain (95%CI 1.0 to 1.1), consistent with regression to the mean and a ceiling effect.

Table 4. Factors associated with knowledge improvement (n=1,106)

Factor	n	Mean pre-test (SD), %	Mean post-test (SD), %	Mean Δ (SD), pp	Passed post-test, n(%)	P value*	Adjusted β (95%CI)†
Professional affiliation						0.55	
Pediatricians	878	40.5 (11.0)	71.4 (12.5)	30.9 (15.2)	786 (89.5)		Ref
General physicians	217	39.3 (11.3)	69.4 (12.7)	30.1 (15.9)	189 (87.1)		2.4 (1.0 to 3.7)
Others	11	37.6 (10.4)	72.1 (10.2)	34.5 (14.2)	11 (100)		3.1 (-1.8 to 8.0)
Age group						<0.001	
≤35 years	17	28.2 (10.7)	48.2 (14.0)	20.0 (14.5)	3 (17.6)		-25.0 (-29.0 to -20.9)
36–45 years	377	38.2 (11.0)	64.3 (12.9)	26.1 (14.6)	302 (80.1)		-8.4 (-9.5 to -7.2)
46–55 years	624	40.9 (10.5)	73.8 (9.5)	32.9 (14.9)	594 (95.2)		Ref
>55 years	88	46.3 (11.4)	84.7 (6.7)	38.4 (14.9)	87 (98.9)		10.7 (8.8 to 12.5)

Δ=post-test minus pre-test score; pp=percentage points; passing=post-test score ≥60%. *Kruskal-Wallis test for the change in score across categories. †Multivariable linear regression with the change in score (pp) as the dependent variable, mutually adjusted for professional affiliation, age group, and pre-test score (β for pre-test score -1.06 per percentage point; 95%CI -1.11 to -1.02; P<0.001); adjusted R^2=0.72; Ref=reference category.

Discussion

This study provides the first multicentre evaluation of the IBFCC. Across 1,106 physicians trained in 17 batches at 13 training sites in 11 provinces, breastfeeding knowledge improved by 30.8 percentage points with a very large effect size (Cohen's d=2.01), and the proportion meeting the competency threshold rose from 6.0% to 89.2%.

The weak correlation between pre-test and post-test scores suggests that post-test performance was largely independent of baseline knowledge, meaning that physicians with both low and high baseline scores benefited substantially from the training. This pattern is consistent with the IBFCC effectively reaching participants across the full spectrum of baseline competency. The strong inverse correlation between baseline score and gain should, however, be interpreted with caution, because it partly reflects regression to the mean and the ceiling imposed by a 15-item instrument.

The IBFCC's effect size substantially exceeds published benchmarks, but the comparison requires care because the reference studies measured different things. The USPSTF-commissioned review of primarily North American and European trials, reported an absolute difference of 0.23 in a clinical outcome (breastfeeding initiation) rather than a knowledge score, and found the largest effects where baseline knowledge was lowest,[16] which is the profile of our cohort (baseline mean 40.2%). A Cochrane review of antenatal breastfeeding education likewise reported effect sizes of 0.5-0.8 for duration and exclusivity outcomes.[28] Knowledge-based CME outcomes are generally larger: a systematic review and meta-analysis of CME strategies spanning 1950-2024 reported a mean effect of d=0.75 for internet-based activities.[29,30] The closest comparator is the multicentre controlled trial of an *American Academy of Pediatrics* residency breastfeeding curriculum, which improved resident knowledge, confidence and practice patterns and was associated with higher breastfeeding rates among their patients.[31] Our larger effect is plausibly attributable to a very low floor, a nine-module curriculum covering all ABM competencies,[13] and facilitator-led delivery. It is also, in part, a property of the outcome measure: immediate recall of taught content is the easiest thing an educational programme can move.

The near-absent baseline knowledge of tongue-tie-related nipple pain (3.1%), followed by a 90.2-percentage-point gain, indicates a near-total absence of this knowledge before training and identifies a remediable deficit with direct clinical consequences, because nipple pain is among the commonest reasons for early breastfeeding cessation. By contrast, knowledge of the appropriate feeding route for a preterm infant born at 29 weeks' gestation improved only modestly (58.5% to 70.1%), so that almost one in three physicians still answered incorrectly after training. This residual gap matters. Indonesia had an estimated 657,700 preterm births in 2020,[9] and human milk is the preferred enteral substrate for preterm infants because of its protection against necrotising enterocolitis (NEC) and late-onset sepsis: each 10% increase in the proportion of intake as human milk reduced the odds of NEC or death by a factor of 0.83 in the NICHD Neonatal Network cohort.[32] A 2025 systematic review and meta-analysis of 20 studies and 6,794 infants found that an exclusive human milk diet was associated with 41% lower odds of Bell stage ≥2 NEC and 57% lower odds of surgical NEC than cow-milk-containing diets,[33] although the causal pathway is contested and is better framed as the harm of the absence of human milk than as toxicity of formula.[34] Module 7 (Breastfeeding Support for Premature and Sick Infants) should therefore be strengthened in future cycles.

The large gains in early initiation of breastfeeding (+73.7%), signs of effective latch and milk transfer (+69.3%), lactogenesis physiology (+58.9%) and infant positioning (+55.2%) map onto the most commonly cited reasons for early breastfeeding cessation worldwide, namely perceived insufficient milk and nipple pain.[35] These groups of items are not independent. Module 1 (Lactation Physiology) supplies the account of milk synthesis and the supply-demand relationship that underlies both the management of perceived insufficient supply and the importance of effective latch and milk transfer, so the physiology module addresses cessation as directly as the clinical modules do, by removing the misconception underlying the commonest reason mothers stop. Conversely, the items with the highest baseline accuracy, increasing milk supply (91.0%) and causes of early nipple pain (85.2%), showed the smallest

positive gains, consistent with a ceiling effect;[25] these items discriminate poorly among physicians and could be replaced by more demanding items. A previous study reported that structured breastfeeding training improved professionals' self-efficacy most in the domains analogous to our highest-gain items,[17] and Cato et al. described corresponding changes in clinical confidence and counselling approach.[18]

Item 9 was essentially unchanged, and items 13 and 15 fell by 22.5 and 15.5 percentage points. A decline in accuracy after teaching is a measurement finding before it is a curricular one, and there are four plausible mechanisms. The item may be ambiguous or double-barrelled, so that better-informed candidates see merit in more than one option.[25] The answer key may have drifted out of step with current evidence, in which case participants taught the current position are marked wrong. Newly learned nuanced content may produce retroactive interference in participants who previously relied on a partially correct heuristic. Finally, later items may suffer fatigue or time pressure in the post-test.[36] We cannot distinguish between these without item-level psychometric data, and we note a fifth possibility the present design cannot exclude: that the relevant material was taught poorly or inconsistently. Classical test theory or item response theory analysis in the next programme cycle should establish whether these items, the answer key, or the teaching require revision.

The near-equivalence of effects in paediatricians (d=2.04, 89.5% passing) and general physicians (d=1.89, 87.1% passing), with no significant difference in increment between affiliations (Mann-Whitney P=0.39) and, if anything, a marginally larger adjusted gain among general physicians, is the finding with the clearest implication for policy, because it means the programme can be scaled to generalists without redesign. That matters in Indonesia, where postnatal care is delivered predominantly by midwives and general practitioners rather than by paediatric specialists, particularly in rural areas and among lower socio-economic groups, and where postnatal care coverage remains among the lowest of all maternal and child health interventions.[37] Expanding IBFCC delivery through IMA provincial branches is therefore a high-leverage strategy for population-level impact. The extension of the *World Health Assembly* global nutrition targets to 2030 similarly emphasises strengthening the competency of the whole health workforce rather than of specialists alone.[7]

Two factors were associated with smaller gains. First, improvement increased with age: participants aged ≤35 years gained 20.0 percentage points and fewer than one in five passed the post-test, whereas those older than 55 years gained 38.4 percentage points and almost all passed, and this gradient persisted after adjustment for baseline score, affiliation and site. This runs counter to the expectation that age-related declines in processing speed and memory would attenuate learning in older adults.[38] A plausible explanation is that greater clinical experience, including experience of counselling breastfeeding families, provides a framework into which new content can be integrated, consistent with adult learning theory.[22] Differences in motivation, career stage and test-taking behaviour may also contribute, and the youngest group was small (n=17), so its estimate is imprecise. Younger physicians, who will practise the longest, may nonetheless need additional case-based reinforcement.

Knowledge improvement is necessary but not sufficient for practice change. Our study sits at Kirkpatrick Level 2 (learning); translation to Level 3 (behaviour) and Level 4 (patient outcomes) requires different designs.[23] A Cochrane review of educational meetings and workshops, found small-to-moderate improvements in professional practice, with the largest effects when education formed part of a multicomponent implementation strategy.[39] IBFCC scale-up should accordingly be paired with *Baby-Friendly Hospital Initiative* implementation, integration of lactation practitioners into neonatal and maternity units, and inclusion of breastfeeding competency in physician performance and recertification frameworks.

The IBFCC produces substantial, consistent and statistically robust improvements in physician breastfeeding knowledge across diverse settings in Indonesia, with a very large overall effect size (Cohen's d=2.01) exceeding established benchmarks in the breastfeeding education and CME literature. The programme is equally effective for paediatricians and general physicians, supporting scalability across the full spectrum of clinical practice. Smaller gains among younger physicians indicate where reinforcement and monitoring of delivery fidelity are needed.

Conflict of interest

None declared.

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