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Cultural and Demographic Socialization Determinants of Mothers' Decisions on DTP Vaccination in Thailand's Southernmost Border Provinces

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Abstract

This study investigated the transition from demographic to socio-cultural determinants of vaccine uptake. A cross-sectional survey was conducted among 1,200 mothers aged 20–50 years in Pattani, Yala, and Narathiwat, using multi-stage stratified random sampling. Data from structured interviews were cross-verified with official Vaccination Record Books. Hierarchical binary logistic regression was employed to assess the incremental explanatory power of socio-cultural socialization variables over baseline demographic factors. The integrated socio-cultural model demonstrated substantially higher explanatory power than the demographic-only model, with Nagelkerke R^2 increasing from 0.224 to 0.498. The strongest predictor of vaccination completion was maternal perception of spousal support (OR = 5.95; 95% CI: 3.15–11.25; $p < .001$), followed by high maternal education (OR = 9.24) and positive engagement with Village Health Volunteers (OR = 2.09). Notably, a "knowledge paradox" emerged: mothers possessing technical knowledge of vaccine ingredients (e.g., gelatin) were significantly less likely to complete the vaccination series (OR = 0.38; $p < .01$), reflecting deep-seated Halal-related concerns. In addition, maternal COVID-19 booster status was strongly associated with child DTP completion (OR = 4.37), suggesting a transfer of vaccine confidence across generations. Overall, DTP vaccination completion in this region is driven more by socio-cultural socialization processes than by demographic characteristics. Maternal agency is substantially moderated by domestic contexts and religio-cultural interpretations of biomedical information. Public health interventions should therefore move beyond maternal-centric outreach toward family-centered and religiously sensitive strategies that directly address theological and ingredient-based concerns.

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Introduction

Despite the availability of effective vaccines, pertussis persists as a formidable threat to pediatric health worldwide, accounting for an estimated 160,700 annual deaths among children under five (World Health Organization [WHO], 2023). This highly contagious respiratory infection, caused by Bordetella pertussis, continues to exert a heavy toll on morbidity and mortality, particularly in regions where immunization coverage remains suboptimal. Severe complications, including pneumonia and seizures, underscore the critical necessity of timely and complete vaccination series during early childhood.

To mitigate this burden, the pertussis vaccine is integrated into the diphtheria-tetanus-pertussis (DTP) combination. While global DTP3 coverage serves as a vital benchmark for health system performance, progress has stagnated in recent years, exacerbated by the COVID-19 pandemic. In 2020, global uptake dropped to 83%, leaving approximately 22.7 million children under-vaccinated, with 17.1 million categorized as "zero-dose" (Muhoza et al., 2021). Consequently, the WHO's Immunization Agenda 2030 has prioritized reaching these vulnerable populations through context-specific and equity-focused interventions.

While Thailand maintains a high national DTP3 coverage rate of 92% (WHO & UNICEF, 2024), significant geographic disparities persist. The southernmost border provinces—Pattani, Yala, and Narathiwat—report coverage levels fluctuating between 60% and 75%, falling substantially below the national average (Ministry of Public Health, 2023). The persistent low uptake in this region characterizes it as a "public health enclave" that necessitates a non-traditional analytical approach beyond standard clinical metrics. Although Thailand's immunization schedule recommends a total of five doses by age six, the completion of the primary three-dose series (DTP3) remains the critical benchmark for establishing herd immunity.

The inadequacy of vaccine coverage is a critical concern across the southern border provinces. In Narathiwat, DTP3 uptake was estimated at only 61% in 2023, while Pattani and Yala provinces also reported coverage rates significantly below the national 90% target, often fluctuating between 65% and 72% in rural districts (Ministry of Public Health, 2023). A recent regional investigation by Mahasing et al. (2024) further highlights the gravity of the situation, revealing that between September 2023 and May 2024, 53.2% of pertussis cases involved "zero-dose" children.

The southernmost border provinces of Thailand are predominantly home to Malay-speaking Muslim communities whose cultural, religious, and linguistic characteristics differ markedly from national norms. Prior studies emphasized demographic variables such as maternal education and income, decision-making in this region is situated within a complex family dynamic where paternal influence plays a decisive role (Asif, Akbar, Tahir, & Arshad, 2019). In this study, this process is framed through Cultural Socialization—defined as the process by which individuals internalize the norms, values, and health beliefs of the Malay-Muslim community. In these traditional structures, the father's consent is often a decisive factor in health-related choices, yet his role remains under-explored in vaccination literature. Furthermore, there is a significant

research gap regarding cultural socialization—defined in this study as the process by which individuals internalize the values, religious interpretations, and community norms of their specific group (Bandura, 1977).

Previous research on cultural socialization has primarily focused on Western contexts, frequently utilizing Western-centric health literacy models that fail to capture the unique socio-religious nuances of the Malay-Muslim culture. There remains a significant research gap in understanding how these socialization processes act as both a barrier and a facilitator within non-Western enclaves. This study fills this gap by examining how specific socialization processes shape actual vaccination outcomes—measured here as the 'completion' status rather than mere 'intention'—reflecting the collective nature of health decisions in this region. Unlike prior studies that viewed vaccination as an isolated maternal choice, this research investigates how maternal knowledge is filtered through theological lenses and communal influences. This is particularly evident in the 'Halal vaccine' discourse (Latiff, Zakaria, & Man, 2021), which this study extends by examining how ‘technical literacy’ regarding vaccine ingredients (e.g., stabilizers like gelatin) may paradoxically act as a barrier. This phenomenon, termed the ‘Knowledge Paradox,’ suggests that in contexts of high religious sensitivity, detailed biomedical information may increase hesitancy when it conflicts with religious identity, highlighting the role of spouses and Village Health Volunteers (VHVs) as essential mediators in the decision-making process.

Despite these alarming statistics, existing literature often fails to quantify the incremental explanatory power of socio-cultural determinants beyond basic demographics. This study addresses this gap by demonstrating that an integrated socio-cultural model—incorporating maternal and paternal factors—provides a statistically significant improvement in predicting actual DTP vaccination completion over traditional models.

Specifically, this study investigates how demographic characteristics, technical vaccine knowledge, and cultural socialization factors influence maternal decisions in Thailand’s southernmost border provinces. By shifting the focus from individual intention to collective behavioral outcomes, this research seeks to contribute to a broader understanding of the intersection between population health and religious identity. Ultimately, these findings aim to inform the design of culturally sensitive and family-centered public health interventions that are locally appropriate for the Malay-Muslim context.

Ultimately, this study investigates how demographic characteristics and socio-cultural socialization factors influence actual vaccination outcomes for children in Thailand’s southernmost border provinces. In doing so, it seeks to contribute to a broader understanding of the intersection between population health, religious identity, and community development, thereby informing the design of culturally grounded and family-centered public health interventions.

Research Objective

The objective of this study was to examine the influence of socio-cultural and demographic socialization determinants on DTP vaccination completion among mothers in Thailand’s

southernmost border provinces , and to evaluate the incremental explanatory power of socio-cultural factors over baseline demographic variables.

Hypothesis

Maternal DTP vaccination decisions in the three southernmost border provinces of Thailand are significantly influenced by cultural and demographic socialization. The following hypotheses are formulated:

H1: (Baseline Demographic Prediction): Maternal demographic and socio-economic factors—specifically higher educational attainment, permanent employment, and household income levels—significantly predict the increased likelihood of DTP vaccination completion.

H2: (Socio-Cultural Incremental Power): Socio-cultural socialization factors—notably paternal influence, neighbors/relatives influence, and active engagement from Village Health Volunteers—exert a dominant effect on vaccination decisions, providing a substantial and significant increase in explanatory power (Nagelkerke R2) over the baseline demographic model.

Literature Review

This study adopted a socio-cultural framework to explore maternal decision-making regarding the completion of the DTP vaccination series in Thailand's three southernmost border provinces: Pattani, Yala, and Narathiwat. This framework integrated both demographic and cultural socialization factors, drawing upon the Social Determinants of Health and established health behavior theories. It posited that vaccination decisions are influenced not only by healthcare access but also by the complex interplay of cultural beliefs, religious teachings, and community norms.

Demographic factors, such as maternal education, income, marital status, and employment are hypothesized to affect health-seeking behaviors and mothers' ability to navigate the vaccination system. For example, higher maternal education is linked to improved health literacy and greater vaccine awareness, which positively influenced vaccine uptake (McNeil et al., 2019; Sahitia et al., 2024). This demographic socialization suggests that a mother's socio-economic background shapes her cognitive approach toward biomedical interventions. Furthermore, socialization through family, religion, and community plays a significant role in shaping attitudes toward vaccination. Within Islamic contexts, religious teachings and community expectations are pivotal in reconciling traditional beliefs with biomedical information. Consequently, cultural socialization factors, including Islamic beliefs, traditional healing practices, and language use, mediate vaccine acceptance.

Cultural socialization factors, including Islamic beliefs, traditional healing practices, and language use, play a critical role in mediating vaccine acceptance. This process manifests in two distinct directions: 1) Positive Religious Socialization, endorsements from religious leaders (Imams) contribute to higher vaccination rates by aligning medical practices with religious duty (Jinarong, Chootong, & Vichitkunakorn, 2023). This reflects similar success stories in neighboring

countries, such as in Indonesia, Santi et al (2025) emphasized that the involvement of religious figures and the issuance of support from Islamic organizations were pivotal in increasing public willingness to accept vaccines, particularly during health crises. In Malaysia, Mustafa, and Zulkipli (2018) highlighted that when vaccination is framed through the lens of Maqasid al-Shariah (protection of life), it significantly enhances maternal trust and reduces hesitation within Muslim communities. 2) Negative Social and Ingredient Concerns, conversely, concerns regarding vaccine ingredients, specifically their permissibility (Halal) under religious law, foster vaccine hesitancy (Daya, Lillahkul, & Kornnoin, 2018). These perspectives are often reinforced through family and community socialization, where traditional healing practices may be prioritized over modern vaccines (Obasohan, Ahmadu, & Ogunniyi, 2021). Furthermore, the influence of informal kinship networks and social media in these regions often reinforces concerns regarding vaccine safety—a challenge that transcends national borders (Wachob, & Boldy, 2019). Crucially, in this "public health enclave," the filter of religious socialization can transform technical medical information into a source of doubt, especially when ingredients are perceived as religiously prohibited.

The Health Belief Model (HBM), as proposed by Rosenstock (1974), posits that health-related actions depend on an individual's perception of the severity of a disease and their susceptibility to it. In this study, HBM elucidates how a mother's "perceived threat" of pertussis and the "perceived benefits" of the DTP vaccine—often weighed against "perceived barriers" such as religious-cultural concerns—shape her final vaccination decision.

Social Learning Theory, as Bandura (1977) emphasizes that health behaviors are learned through observation and imitation of others within a social context. This theory highlights the role of "cues to action" provided by respected community figures, suggesting that mothers are more likely to complete the DTP series when they observe positive maternal perception of spousal support, coupled with proactive guidance from neighbors and Village Health Volunteers (VHVs). Building on this social perspective, Wahab et al. (2018) underscore the necessity of Socio-Cultural Integration, which involves aligning psychological models with local cultural nuances. Their work highlights that in Muslim-majority regions, health beliefs are often inseparable from religious identity. Consequently, effective "cues to action" for vaccination frequently stem from spousal encouragement and communal reinforcement rather than isolated biomedical advice.

Socialization within religious and communal settings shapes mothers' perceptions of vaccines in relation to cultural and religious norms. Barriers to vaccination frequently arise from a complex interplay of logistical, cultural, and religious challenges. These socialization processes can sometimes reinforce resistance to vaccination, particularly when traditional or religious beliefs conflict with biomedical practices. However, maternal education serves to mitigate such barriers by fostering trust in vaccines and enhancing health literacy, although mothers in rural settings continue to encounter unique context-specific challenges (Jinarong, Chootong, & Vichitkunakorn, 2023).

Globally and locally, pertussis remains a significant public health concern, as suboptimal vaccination coverage contributes to periodic outbreaks (WHO, 2023). In Thailand, DTP vaccination

rates below 80% are associated with an increased risk of pertussis outbreaks, underscoring the critical necessity of complete immunization (Ministry of Public Health, 2023; WHO, 2021). In the southernmost border provinces, coverage remains significantly lower than the national average, highlighting the urgent need for culturally responsive interventions that address the unique socio-religious barriers of this region (Daya, Lillahkul, & Kornnoin, 2018).

This literature review underscores the critical importance of socialization in shaping vaccine decision-making among mothers in Thailand's southernmost border provinces. Culturally tailored interventions that address both demographic and social factors—including education, income, and religious beliefs—are essential for improving vaccination rates and reducing the burden of vaccine-preventable diseases. While the conceptual framework primarily emphasizes maternal factors, it also acknowledges the significant influence of the paternal context on maternal decisions. Accordingly, selected paternal demographic variables were incorporated into the logistic regression model to examine their potential contribution. Consequently, the synthesized findings from the literature and the conceptual considerations led to the development of the research framework that guided the study's design, variable selection, and analytical approach.

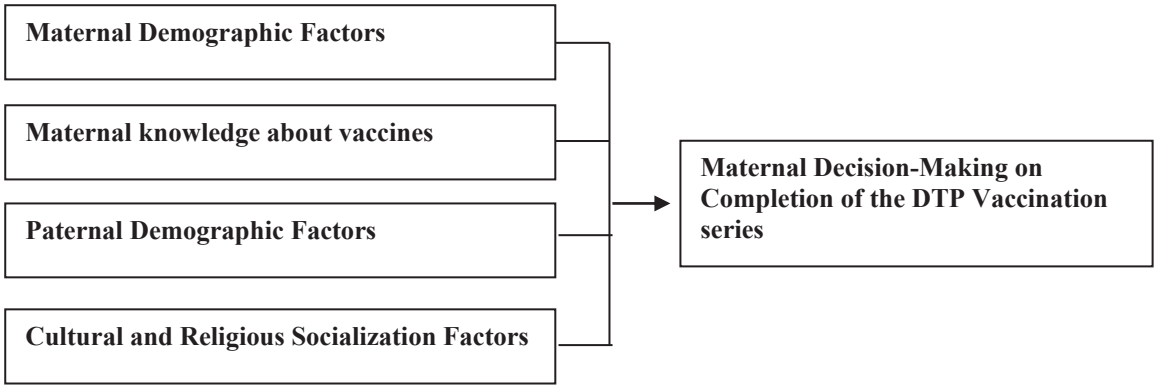
Research Framework

Based on insights gained from the literature review and the conceptual framework, this research framework is developed to guide the empirical investigation of factors influencing maternal decision-making regarding DTP vaccination completion in Thailand's southernmost border provinces. It integrates maternal and paternal demographic characteristics, cultural and religious influences, and socialization processes within family and community contexts. Informed by socio-cultural perspectives and health behavior theories— specifically the Health Belief Model and Social Learning Theory—the framework illustrates the hypothesized relationships among key variables. It serves as the foundation for identifying relevant variables, designing data collection instruments, and selecting appropriate analytical methods, including hierarchical logistic regression. The framework aims to capture the complexity of vaccine decision-making in culturally diverse and religiously significant communities.

Consequently, this framework informs the study's design, variable selection, and the analytical approach. The conceptual relationships proposed are visually depicted in the Diagram 1. This framework illustrates the hypothesized relationships between maternal and paternal demographic factors, maternal knowledge about vaccines, cultural and religious socialization, and the completion of the DTP vaccination series (at least 3 doses).

Diagram 1

Research framework of the study



Research Methodology

Study Design

This study utilized a quantitative research approach with a cross-sectional survey design. Cross-sectional studies collect data from a defined population at a single point in time, making them ideal for assessing the factors influencing childhood vaccination coverage. This design allows for the identification of associations between independent variables and vaccination adherence, but it does not establish causality.

Study Population

The target population consisted of mothers aged 20 to 50 years residing in the southernmost border provinces of Thailand (Pattani, Yala, and Narathiwat). The total population across these three provinces is approximately 448,939 individuals (Department of Provincial Administration, 2022). Inclusion Criteria, participants were eligible if they were the primary caregiver and had at least one child aged five years or older, ensuring a complete window to evaluate adherence to the national vaccination schedule. Exclusion Criteria, mothers with cognitive impairments that precluded informed consent or those who had resided in the area for less than six months were excluded to ensure data reliability and local contextual relevance.

Sample Size and Sampling Method

This study employed a multi-stage stratified random sampling technique to ensure a proportional representation of both urban (municipal) and rural (non-municipal) populations within each targeted province. The minimum sample size was determined using the formula proposed by Fisher and Gitelson (1983), a widely recognized standard in public health research. While the initial calculation required 1,153 participants, the final sample was increased to 1,200 to mitigate potential bias arising from nonresponse or missing data.

The sampling process was executed through two distinct phases. First, the population underwent stratification based on provincial boundaries and residential zones (Urban vs. Rural). Subsequently, simple random sampling was conducted systematically across the district, sub-district, and village levels within each established stratum.

By employing such a rigorous framework, the study significantly enhances its external validity. This methodical approach effectively captures the diverse socio-cultural and demographic variations unique to the southernmost border region, ensuring that the findings accurately reflect this specific geographical and social context.

Research Instruments and Quality Assessment

The primary instrument for data collection was a structured questionnaire comprising a total of 32 items, meticulously developed through a synthesis of contemporary literature and grounded in the Health Belief Model (HBM), Social Learning Theory (Bandura, 1977), and Andersen's Behavioral Model. The instrument was designed to capture the multi-dimensional nature of vaccination decisions in the unique socio-cultural context of Thailand's southernmost border provinces. It was organized into four key sections: (1) socio-demographic profiles of both parents; (2) maternal vaccine knowledge; (3) cultural and religious socialization, including the influence of religious leaders (Imams) and Village Health Volunteers; and (4) the child's DTP vaccination status, verified through official Vaccination Record Books.

To ensure psychometric integrity, the instrument underwent a rigorous validation process by a panel of five experts specializing in public health, epidemiology, and Islamic studies, yielding Index of Item-Objective Congruence (IOC) scores between 0.80 and 1.00. Subsequently, a pilot study was conducted with 30 mothers in Narathiwat province to assess feasibility and reliability. The vaccine knowledge section, utilizing binary outcomes, achieved a Kuder-Richardson 20 (KR-20) coefficient of 0.935, while the perceived risk and socialization scales attained Cronbach's Alpha coefficients ranging from 0.78 to 0.916, both significantly exceeding the acceptable threshold of 0.70. Furthermore, service satisfaction was measured using a numeric rating scale (0–10); based on the pilot study's results, a mean score of 7.70 was established as the cutoff point to dichotomize participants into 'Satisfied' and 'Unsatisfied' groups for subsequent multivariate analysis.

Fieldwork was conducted from February to April 2023, following formal ethical approval from the Research Ethics Committee for Humanities, Social Sciences and Education, Prince of Songkla University, Pattani Campus (Approval Code: [psu.pn.2-063/64]). To ensure data quality and minimize social desirability bias, local research assistants fluent in both Thai and the Melayu/Yawi dialect were recruited. All enumerators underwent rigorous calibration training to standardize interview techniques and mitigate bias. Ethical standards were strictly maintained throughout the structured interviews. Written informed consent was obtained from all participants, who were provided with explicit assurances of anonymity and confidentiality. Furthermore, participants were reassured that their honest reporting was vital and would not affect their future access to healthcare services. This comprehensive approach was designed to foster trust and ensure the reliability of self-reported data within these sensitive community settings.

Variables and Measurements

The study variables were operationalized and categorized into a dependent factor and four dimensions of independent predictors, grounded in the conceptual framework of maternal

decision-making and socio-cultural socialization. The dependent variable was the completion of the DTP vaccination schedule, treated as a binary outcome where a value of 1 was assigned if the child had received at least the primary series (≥ 3 doses), and 0 represented fewer than three doses. Data were primarily verified through the child's Vaccination Record Book or maternal verbal reports in its absence.

Regarding the independent variables, they were structured into four primary dimensions. First, maternal and paternal demographic factors for both parents included age, dichotomized into less than 36 years (reference) and 36 years and over, and marital status, categorized into informal marriage (reference) and legally married. Educational attainment was grouped from lower secondary (reference) to higher education. Occupation was categorized by income stability, specifically comparing non-permanent or irregular income as the reference against private sector employees and those with permanent income, such as government or state enterprise employees. Monthly income was further bracketed from less than 5,000 THB (reference) to 20,000 THB and above.

Second, household structural and contextual factors included the total number of household members and residential area, with municipal areas serving as the reference for non-municipal comparisons. The study spanned three provinces, using Pattani as the reference for Yala and Narathiwat. Notably, the primary language for healthcare communication distinguished between Standard Thai or Southern Thai (reference) and the local Malay dialect.

Third, the social and cultural socialization dimension assessed religious background, comparing Buddhism (reference) with Islam, and the presence of external influences. This included recording the presence or absence (reference) of influence from the child's father, neighbors/relatives influence, and Village Health Volunteers on immunization decisions.

Finally, healthcare experience and vaccination history integrated maternal knowledge and behavioral beliefs. Maternal knowledge was evaluated through specific items on DTP initiation, vaccine components, and side effects, each dichotomized into correct and incorrect (reference) responses. This dimension also captured satisfaction with healthcare providers and family beliefs, where "against vaccination" served as the reference for "not against." Maternal concerns were recorded as none (reference) or concerned. Additionally, previous immunization behavior, specifically maternal COVID-19 vaccination status, was utilized as a proxy for vaccine acceptance, comparing the unvaccinated or incomplete group (reference) against those who had completed the primary series or received a booster dose.

Statistical Analysis

Data were analyzed using descriptive and inferential statistics. Prior to model construction, multicollinearity among independent variables was assessed using the Variance Inflation Factor (VIF), with a threshold of VIF>10 used to identify and exclude redundant variables. To identify predictors of DTP vaccination completion, a binary logistic regression model was employed, specified as:

$$log\ (P / (1 - P)) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n,$$

Where P represents the probability of a child receiving ≥3 doses of the DTP vaccine, β_0 is the intercept, and β_1, β_2, ...,β_n are the regression coefficients for the independent variables. Results were reported as Odds Ratios (OR) with 95% confidence intervals (CI). An OR>1 indicates an increased likelihood of vaccination completion, while an OR<1 indicates a decreased likelihood. Model calibration was evaluated using the Hosmer-Lemeshow goodness-of-fit test, where a p-value > 0.05 signifies an acceptable fit between the model and empirical data. Additionally, the Nagelkerke R2 statistic was utilized to determine the proportion of variance explained by the independent variables, providing a measure of the model's overall explanatory power.

Results

This study examined the influence of cultural and demographic socialization factors on mothers' decisions to complete the DTP vaccination series for their children in Thailand's three southernmost border provinces. Table 1 shows the demographic characteristics of the respondents (N=1,200).

Maternal and Paternal Demographic Factors

The median age of the mothers was 36.0 years (Mean age = 35.31, S.D. = 6.808), ranging from 20 to 50 years. The sample was nearly evenly split between those aged less than 36 years (49.8%) and those 36 years and over (50.2%). The majority of respondents identified as Muslim (80.8%), while 19.2% were Buddhist. When examining the language of daily life, 64.3% primarily spoke Local Malay, followed by Southern Thai dialect (24.3%) and Thai (11.5%).

Regarding marital status, 61.8% of respondents were legally married, while 29.2% were religiously married; the remaining 9.0% were widowed (5.0%), divorced (2.6%), or separated (1.4%). Educational attainment varied, with 28.2% of mothers having earned a bachelor's degree or higher, followed by 20.6% who completed upper secondary education and 19.7% with primary school education. In terms of occupation, the largest group was housewives (40.2%), followed by general laborers or private sector employees (31.8%). Additionally, 11.3% were private business owners or entrepreneurs, 9.0% were government employees, and smaller proportions were engaged in agriculture or fisheries (2.8%), state enterprises (2.2%), or were unemployed (2.8%). Concerning maternal monthly income, the majority of respondents were in the lower income brackets; 43.3% earned less than 5,000 THB, while 31.3% earned between 5,000 and 9,999 THB. Smaller proportions reported higher monthly incomes, with 11.8% earning 10,000–19,999 THB and 13.7% earning 20,000 THB or more.

Among the fathers, the median age was 40.0 years (Mean = 40.07, S.D.= 8.59), with a range of 20 to 66 years. In terms of educational attainment, the most common level was primary school or equivalent (23.3%), followed by a bachelor's degree or higher (21.5%), and lower

secondary education (20.1%). Other educational levels included upper secondary education (17.5%), diploma or higher vocational certificates (8.0%), and vocational certificates (5.1%), while 4.5% had no formal education.

Regarding employment, a significant majority of the fathers (61.6%) worked as general laborers or in the private sector. Other occupations included private business owners or entrepreneurs (13.1%), government employees (8.5%), and those in the agriculture or fisheries sector (7.0%). Smaller proportions were househusbands (3.8%), unemployed (3.4%), or state enterprise employees (2.7%).

Paternal monthly income was largely concentrated in the lower brackets: 40.0% earned between 5,000 and 9,999 THB, and 30.8% (n = 370) earned less than 5,000 THB. Only 14.8% reported earning 10,000–19,999 THB, and 14.3% earned 20,000 THB or more.

Household Structure and Contextual Factors

Regarding the economic profile of the households, the largest proportion of families earned between 5,000 and 9,999 THB per month (36.9%), followed by those earning 20,000 THB or more (23.8%). Households with monthly incomes between 10,000 and 19,999 THB accounted for 20.3%, while the lowest income bracket (less than 5,000 THB) represented 19.0% of the sample.

The analysis of household composition revealed a mean household size of 5.1 members (S.D. = 1.857), with a median of 5.0 persons. These households ranged from small nuclear families of two members to large extended families with up to 16 residents. Similarly, the mean number of children per household was 2.6 (S.D. = 1.494), with a median of 2.0 children. The number of children ranged from 1 to as many as 9 per family, reflecting the prevalent extended family structures and higher fertility rates characteristic of the southernmost border provinces.

In terms of residential context, the distribution was nearly balanced, with 51% of participants residing in municipal (urban) areas and 49% in non-municipal (rural) areas. This geographic balance ensures that the study captures variations in vaccine accessibility and socialization influences across different living environments within Pattani, Yala, and Narathiwat.

Healthcare Experience and Vaccination History

The assessment of children's health status revealed that the vast majority were reported as healthy (96.7%), while a small minority (3.3%) had underlying or recurring health issues.

Maternal COVID-19 vaccination history was analyzed as a proxy for general vaccine acceptance and engagement with public health initiatives. The data showed high uptake, with only 9.3% of mothers remaining unvaccinated. Among those vaccinated, the most common regimen was two doses of Sinovac followed by an AstraZeneca booster (42.8%), followed by two doses of AstraZeneca (28.9%), and two doses of Pfizer (10.9%). Approximately 8.2% had received at least one dose of any vaccine type.

Regarding the primary outcome variable—Diphtheria-Tetanus-Pertussis (DTP) vaccination status—the mean number of doses received was 4.10 (S.D. = 1.61), with a median of 5.00 doses. While the number of doses ranged from 0 to 5, the majority of children (85.0%) had successfully

completed the primary series (at least three doses). However, 15.0% of the children remained under-vaccinated, having received fewer than three doses. This 15% gap represents a significant pocket of vulnerability in the southernmost border provinces, falling below the World Health Organization's (WHO) recommended threshold for robust herd immunity.

Table 1

Demographic and socioeconomic characteristics of mothers and their husbands in the southernmost border Provinces of Thailand

Variables	Number	Percentage
Maternal Demographic Factors		
Age		
The median age of mothers was 36.0, Mean = 35.31, S.D. = 6.808, Min = 20, Max = 50		
Aged less than 36 years	49.8	597
Religious background		
Islam	80.8	970
Buddhism	19.2	230
Language of daily life (®)		
Local Malay	64.3	771
Thai	11.5	138
Southern Thai dialect	24.3	291
Marital status		
Religious married	29.2	350
Legally married	61.8	742
Widowed	5.0	60
Divorced	2.6	31
Separated	1.4	17
Area of Residence		
Non-Municipal	49.0	588
Municipal	51.0	612
Education level		
No formal education	2.5	30
Primary School or Equivalent	19.7	236
Lower Secondary School or Equivalent	14.3	172
Upper Secondary School or Equivalent	20.6	247
Vocational Certificate or Equivalent	3.0	36
Diploma/ Higher Vocational Certificate	11.8	141
Bachelor's Degree & Higher	28.2	338

Table 1 (Continue)

Variables	Number	Percentage
Occupation		
Unemployed	2.8	33
Housewife/ housework	40.2	482
Government employee	9.0	108
General Laborer/ Private sector	31.8	381
Private business/ Entrepreneur	11.3	136
Agriculture/Fisheries	2.8	34
State enterprise employee	2.2	26
Income		
Less than 5,000 THB	43.3	519
5,000 - 9,999 THB	31.3	375
10,000 - 19,999 THB	11.8	142
20,000 THB and above	13.7	164
Paternal Demographic Factors		
Age		
The median age of their husbands was 40, Mean = 40.07, S.D. = 8.59, Min = 20, Max = 66		
Paternal's education		
No formal education	4.5	54
Primary school or equivalent	23.3	280
Lower secondary school or equivalent	20.1	241
Upper secondary school or equivalent	17.5	210
Vocational certificate or equivalent	5.1	61
Diploma/ higher vocational certificate	8.0	96
Paternal occupation		
Unemployed	3.4	41
Househusband/ housework	3.8	45
Government employee	8.5	102
General Laborer/ private sector	61.6	739
Agriculture/ Fisheries	7.0	84
Private business/ entrepreneur	13.1	157
State Enterprise employee	2.7	32
Paternal income		
Less than 5,000 THB	30.8	370
5,000 - 9,999 THB	40.0	480
10,000 - 19,999 THB	14.8	178
20,000 THB and above	14.3	172

Table 1 (Continue)

Variables	Number	Percentage
Household Structure		
Income of the household		
Less than 5,000 THB	19.0	228
5,000 - 9,999 THB	36.9	443
10,000 - 19,999 THB	20.3	244
20,000 THB and above	23.8	285
The median household size was 5.0 persons, mean household size was 5.1 members, Min = 2, Max = 16, S.D. = 1.857 **The median of children' s number was 2.0 persons, mean of children's number was 2.6 persons, min = 1, max = 9, S.D. = 1.494**		
Healthcare Experience and Beliefs		
Health status of children		
Unhealthy	3.3	40
Healthy	96.7	1,160
COVID-19 vaccine		
Not received at all	9.3	111
Complete 2 doses of Sinovac and 1 booster dose of AstraZeneca	42.8	513
Complete 2 doses of AstraZeneca	28.9	347
Complete 2 doses of Pfizer	10.9	131
1 dose of any type	8.2	98
Diphtheria-Tetanus-Pertussis (DTP) Vaccine		
The median of number DTP doses was 5.00, Mean = 4.10, S.D. = 1.61, Min = 0, Max = 5		
Received fewer than three doses	15.0	180
Completed at least three doses	85.0	1,020

Results of Logistic Regression Analysis

Model 1: Baseline Demographic and Contextual Analysis

Model 1 was developed to analyze the fundamental influence of 12 independent variables on the likelihood of immunization completion (attaining at least 3 doses of the DTP vaccine). This model established a baseline by examining factors across three primary dimensions: maternal factors, paternal factors, and contextual/family factors. Maternal factors included age, marital status, education level, occupation, monthly income, and the communication language used

at healthcare facilities. Paternal factors comprised education level, occupation, and monthly income. Finally, contextual and family factors included residential area (municipal vs. non-municipal), province of residence, and household size.

The 12 baseline variables collectively explained 22.4% of the variance in DTP vaccination completion (Nagelkerke R^2 =.224). The model demonstrated an acceptable fit with the empirical data, as indicated by the Hosmer and Lemeshow Test (χ^2 =13.179, df=8, p=.106). A p-value greater than .05 suggests that the model's predictions are not significantly different from the observed data. The total unexplained variance, represented by the -2 Log likelihood, was 850.416.

Maternal education was a significant predictor, as mothers with higher education (Bachelor's degree or higher) were 4.72 times more likely to achieve vaccination completion (OR = 4.722, 95% CI = 2.405–9.272) compared to those with lower secondary education.

Regarding geographic and residential factors, mothers residing in Yala Province had a 3.38 times higher likelihood of ensuring full vaccination (OR = 3.381, 95% CI = 1.711–6.682) compared to those in Pattani. Additionally, those living in non-municipal areas (rural/suburban) were 2.27 times more likely to reach completion (OR = 2.267, 95% CI = 1.527–3.367) than those in municipal areas.

In terms of economic factors, mothers with permanent occupations showed a 2.53 times higher likelihood of completion (OR = 2.527, 95% CI = 1.216–5.254). Analysis of monthly income revealed that mothers earning 5,000–9,999 THB/month were 2.02 times more likely to complete the series (OR = 2.018, 95% CI = 1.181–3.448) compared to the lowest income group (< 5,000 THB). Conversely, mothers in the 10,000–19,999 THB bracket were 78.6% less likely to complete vaccinations (OR = 0.214, 95% CI = 0.108–0.422).

Paternal influence also played a role, with fathers employed as private sector employees or general laborers increased the likelihood of completion by 2.02 times (OR = 2.017, 95% CI = 1.185–3.433) compared to those with irregular income. Finally, household complexity had an inverse relationship with the outcome; for every additional household member, the likelihood of vaccination completion decreased by 15.2% (OR = 0.848, 95% CI = 0.775–0.929).

Overall, the findings from Model 1 highlighted that maternal education and geographic location (Yala and rural areas) served as the primary baseline drivers for vaccination. However, the Nagelkerke R^2 value of .224 suggested that nearly 77% of the factors influencing vaccination decisions remained unexplained by demographic and economic variables alone, thereby justifying the need for the integrated approach implemented in Model 2.

Statistical Analysis of Model 2: Integrated Socio-Cultural and Experience Factors

Model 2 was constructed by adding 12 additional variables to the baseline model, focusing on social influences, cultural beliefs, vaccine knowledge, and personal experiences. This integrated approach aimed to capture the complex decision-making landscape in the southernmost border provinces. The 12 additional variables comprised social and cultural influences (religion, paternal influence, neighbor/relative influence, and Village Health Volunteer

influence), knowledge and perception (maternal knowledge score, DTP initiation knowledge, ability to identify vaccine components, and perceived side effects), healthcare experience and beliefs (satisfaction with providers, family beliefs about vaccination, and specific concerns), and previous immunization behavior (maternal COVID-19 vaccination status).

The inclusion of these socio-cultural and experience-based variables caused the model's explanatory power to surge to 49.8% (Nagelkerke R2 = .498), more than double the predictive power of Model 1. The model demonstrated an excellent fit with the empirical data (Hosmer and Lemeshow χ^2 =5.069, df=8, p=.750). The high p-value confirms the model's high accuracy in predicting vaccination completion, while the -2 Log likelihood decreased significantly to 613.795, indicating a substantial reduction in model error.

Key significant predictors in Model 2 highlighted that social support and practical knowledge were the most influential drivers of completion. The multivariable analysis revealed that maternal perception of spousal support was one of the strongest predictors of DTP completion. Mothers who perceived their spouses as supportive were nearly six times more likely to ensure their children completed the primary DTP series (OR = 5.952; 95% CI: 3.148–11.253) compared to those who perceived a lack of support. Similarly, positive influence from VHVs doubled the odds of completion (OR = 2.085, 95% CI = 1.249–3.482).

In terms of practical knowledge and technical detail, understanding the correct timing for DTP initiation (starting at 2 months) significantly increased completion likelihood by 4.9 times compared to those with incorrect knowledge (OR = 4.901, 95% CI = 2.751–8.734). Conversely, mothers who could identify specific vaccine components—such as the presence of gelatin, thimerosal (mercury), or heavy metals, even in trace amounts—were 62.5% less likely to complete DTP vaccinations compared to those who could not identify such components (OR = 0.375, 95% CI = 0.208–0.673). Furthermore, those influenced by neighbors or relatives experienced a 70.2% decrease in the likelihood of completion (OR = 0.298, 95% CI = 0.151–0.587). Regarding vaccine confidence and experience, mothers with a history of receiving a COVID-19 booster were 4.37 times more likely to ensure their child's DTP completion (OR = 4.374, 95% CI = 2.251–8.503). Additionally, those who perceived that their children would not experience side effects were 3.03 times more likely to reach completion (OR = 3.030, 95% CI = 1.744–5.261).

The logistic regression analysis revealed a counterintuitive finding that challenges traditional health literacy models. Contrary to general expectations, specific maternal knowledge regarding vaccine components (e.g., identifying ingredients like gelatin or thimerosal) was negatively associated with DTP completion. While 85.0% of the general sample successfully completed the primary series, those with this specific technical literacy were 62.5% less likely to do so (OR=0.375, 95%CI:0.208–0.673, p<.01). This confirms that in Thailand's southernmost border provinces, technical medical knowledge functions paradoxically as a barrier rather than an enabler, as such information is likely filtered through religious and cultural lenses—a phenomenon termed the 'Knowledge Paradox'.

Table 2

Factors influencing mothers' DTP vaccination decisions in southernmost border Provinces of Thailand

Variables	Model 1		Model 2	
	OR	95%CI	OR	95%CI
Maternal Demographic Factors				
Age (Less than 36 year®)				
36 years and over	.946	.660-1.354	1.759*	1.112-2.782
Marital status				
(Illegally married/ informal married®)				
Legally married/ ever-married	.968	.649-1.443	1.003	.593-1.697
Education level (Lower secondary®)				
Upper secondary/ vocational certificate	.885	.569-1.377	1.208	.713-2.044
Higher education	4.722***	2.405-9.272	9.237***	4.268-19.993
Occupation				
(Unemployed/ irregular income®)				
Private sector employee/ general laborer	.657	.424-1.016	.447**	.253-.789
Permanent income/ government/ state enterprise	2.527*	1.216-5.254	1.951	.826-4.608
Income/month (Less than 5,000 THB ®)				
5,000–9,999 THB	2.018*	1.181-3.448	1.774	.902-3.489
10,000–19,999 THB	.214***	.108-.422	.170***	.074-.387
20,000 THB and above	.380	.119-1.213	.392	.101-1.525
Paternal Demographic Factors				
Education Level (Lower secondary®)				
Upper secondary/ vocational certificate	.991	.619-1.588	.703	.392-1.260
Higher education	.888	.446-1.769	.285**	.123-.659
Occupation				
(Unemployed/ irregular income®)	2.017*	1.185-3.433	2.591**	1.362-4.927
Private sector employee/General laborer				
Permanent income/ government/ state enterprise	1.288	.657-2.526	1.760	.781-3.967
Income/month (Less than 5,000 THB ®)				
5,000–9,999 THB	1.280	.816-2.007	2.255**	1.251-4.062
10,000–19,999 THB	.959	.462-1.991	.871	.361-2.098
20,000 THB and above	1.632	.569-4.680	1.853	.457-7.508

Table 2 (Continue)

Variables	Model 1		Model 2	
	OR	95%CI	OR	95%CI
Family Structural Factors				
Number of households	.848***	.775-.929	.731***	.645-.828
Area Residence (Municipal®)				
Non-municipal	2.267***	1.527-3.367	2.680***	1.595-4.503
Province (Pattani®)				
Narathiwas	.764	.504-1.158	.290***	.155-.546
Yala	3.381***	1.711-6.682	4.460*	1.006-19.784
language for communicating with the healthcare facility staff (Central Thai and Southern Thai®)				
Local Malay	1.028	.666-1.584	1.355	.792-2.317
Social and Cultural Factors				
Religious (Buddhism®)				
Islam	-	-	4.279	.913-20.055
Maternal perception of spousal support (No®)				
Yes	-	-	5.952***	3.148-11.253
Neighborhood/ relatives influence (No®)				
Yes	-	-	.298***	.151-.587
Village Health Voluntee influence (No®)				
Yes	-	-	2.085**	1.249-3.482
Knowledge & Perception				
Maternal vaccine knowledge score	-	-	1.157***	1.075-1.246
DTP Initiation Knowledge (Incorrect®)				
Correct	-	-	4.901***	2.751-8.734
Identified vaccine components (Incorrect®)				
Correct	-	-	.375**	.208-.673
Perceived Side Effects (Incorrect®)				
Correct	-	-	3.030***	1.744-5.261

Table 2 (Continue)

Variables	Model 1		Model 2	
	OR	95%CI	OR	95%CI
Healthcare Experience & Beliefs				
Satisfaction with regular healthcare providers	-	-	1.187**	1.056-1.334
Belief about vaccination within the family				
(Againt®)	-	-	2.023	.998-4.099
No against				
Concern about child vaccination (None®)	-	-		
Concern	-	-	.510*	.291-.862
Previous Immunization Behavior				
COVID-19 Vaccine				
(Unvaccinated / Incomplete®)				
Primary series				
(Complete 2 doses of AZ/ Pfizer)	-	-	2.659**	1.380-5.125
Booster Dose	-	-	4.374***	2.251-8.503
R2	.224		.498	
df	21		34	
-2Loglikelihood	850.416		613.795	
Hosmer and Lemeshow χ^2	13.179		5.069	
df	8		8	
p-value	.106		.750	

Note: *$p < .05$, **$p < .01$, ***$p < .001$; OR = Odds Ratio, ® = Reference Group

Discussion

The findings demonstrate that transitioning from a baseline demographic model to an integrated socio-cultural model significantly enhances the explanatory power regarding DTP vaccination completion. The substantial increase in the Nagelkerke R2 value from 22.4% to 49.8% confirms that in Thailand's southernmost border provinces, vaccination behavior is not merely a product of individual socioeconomic status, but a deeply socialized process. This shift supports the application of Social Learning Theory (Bandura, 1977), suggesting that the 'social environment'—comprising spousal influence and community reinforcement—is a more potent determinant of health outcomes than maternal age or income alone.

A pivotal finding is the profound impact of maternal perception of spousal support (OR = 5.952, p <.001). Within this socio-cultural context, decision-making is an intra-familial negotiation rather than an individual maternal act. While the mother is the primary caregiver,

her health-seeking behavior is heavily moderated by the perceived approval of her spouse, aligning with the patriarchal social structure of Malay-Muslim communities where spousal concurrence acts as a primary "cue to action." This finding resonates with Azubuike & Ardelt (2021) and Assefa et al. (2025), confirming that in traditional societies, vaccine acceptance is contingent upon the power balance within the family unit. Consequently, the father's involvement is not just supportive but essential for the success of the National Immunization Program.

Furthermore, a critical "knowledge paradox" emerged: specific maternal knowledge regarding vaccine components (e.g., gelatin) was negatively associated with completion (OR = 0.375, $p<.01$). This aligns with the "Halal vaccine" discourse (Latiff, Zakaria, & Man, 2021), where technical knowledge without religious reassurance triggers fears of Haram (religious non-permissibility). As suggested by Kisa & Kisa (2024), biomedical information in Islamic contexts is often mediated by religious beliefs; when presented in a vacuum—devoid of official Fatwas or religious contextualization—it may be perceived as a risk to spiritual purity. This indicates that in this subnational context, "more information" does not automatically translate to "more trust."

Finally, the study highlights the tug-of-war between informal and formal social networks. Negative influence from neighbors reduced completion odds by 70.2% (OR = 0.298, $p<.001$), supporting Brunson's (2013) view that informal networks often override medical advice, especially when amplified by social media (Wachob & Boldy, 2019). Conversely, Village Health Volunteers (VHVs) doubled the likelihood of completion (OR = 2.085, $p<.01$), acting as trusted intermediaries who provide culturally aligned cues. While maternal education remains a robust "cognitive shield" (OR = 9.237), the overarching driver of success in this region is the shift from maternal-centric toward family-centered and religiously sensitive public health strategies.

Conclusion and Implication

This study concluded that the completion of the DTP vaccination series among mothers in Thailand's southernmost border provinces is determined by a complex synergy of demographic socialization and socio-cultural determinants. The research findings validated that while maternal education is a significant foundational predictor, the transition from a baseline model (R^2=22.4%) to an integrated socio-cultural model (R^2 =49.8%) revealed that social influences are the dominant drivers of health behavior in this region.

The most critical determinant identified was paternal influence, which increased the likelihood of vaccine completion by nearly sixfold. This finding highlights a patriarchal decision-making structure where the father's endorsement serves as the primary "cue to action." Furthermore, while higher education empowers mothers, technical knowledge regarding vaccine ingredients—when presented without religious framing—paradoxically increases hesitancy due to Halal concerns. Ultimately, the study confirmed that vaccination in this context is a collective

family and communal act rather than an isolated maternal decision, heavily mediated by religious identity and local social networks.

The study provides an expansion of Bandura's Social Learning Theory (1977) by identifying specific "trusted models" within a religious context. It proves that in the southern border provinces, the "social" in social learning is hierarchical, moving from religious leaders and fathers to mothers. Additionally, the findings suggest that "Perceived Barriers" in Muslim-majority regions are not merely logistical but are deeply ontological, tied to notions of religious purity and communal belonging.

From Maternal-Centric to Family-Centered Outreach, Public health interventions should transition from a strictly maternal-centric model to a family-centered support strategy. Since maternal perception of spousal support (OR = 5.952) is the strongest predictor of completion, immunization campaigns should focus on creating a supportive domestic environment. Rather than targeting mothers in isolation, health outreach should provide materials designed for the entire household. This ensures that the information the mother receives is validated by her spouse, thereby reducing internal domestic conflict regarding vaccine safety. By providing vaccine education in communal spaces frequented by the family unit (e.g., community centers or via religious leaders), the health system can foster a "culture of approval" that empowers the mother to act on her positive intentions without fear of domestic resistance. This shift recognizes the father not as a passive observer, but as a primary stakeholder in childhood immunization.

Religious-Biomedical Integration communication: To address the "Ingredient Paradox" (OR=0.375), the Ministry of Public Health should collaborate with the Provincial Islamic Committee to issue clear guidelines (Fatwas) regarding vaccine ingredients. Such collaborations should aim to bridge the gap between biomedical facts and religious permissibility (Halal), thereby neutralizing the anxiety triggered by informal peer networks.

Empowering VHVs as Cultural Ambassadors: Village Health Volunteers (OR=2.085) should be trained not only in biomedical monitoring but also in "cultural competency" to effectively counteract misinformation spread within local kinship networks (OR=0.298).

Future studies should delve deeper into the specific communication dynamics within the household to better understand how mothers navigate the negotiation between biomedical advice and spousal expectations. Additionally, given the significant negative impact of informal kinship networks found in this study, further research is highly recommended to investigate how social media narratives (e.g., via WhatsApp or Facebook groups) in local Patani Malay dialects shape maternal vaccine confidence. Exploring these digital socialization channels will provide a more comprehensive view of the information landscape that mothers must filter when making health decisions for their children.

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