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Shifting the Paradigm of Autism Early Intervention in Thailand: A Pilot Study of the THAI Model

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Abstract

This study examines the Thai Home-based Autism Intervention (THAI) model, a parent-mediated, play-based approach designed to shift the paradigm from a medical model to a family-centered framework, addressing systemic inequities in early ASD care. This was a quasi-experimental pilot study conducted over six months in five provincial hospitals. Forty-six caregiver-child pairs participated in the intervention, which included biweekly in-clinic I-CARE skills coaching (Interaction, Comfort, Adapt, Respond, Encouragement), parent support groups, and home-based activities. Outcomes were assessed using the Functional Emotional Assessment Scale (FEAS), I-CARE Assessment, and Parenting Stress Index-Short Form (PSI-SF). Parent-child interaction improved significantly (I-CARE scores increased from 12.69 ± 5.08 to 16.60 ± 6.45, $p < .001$), as did children's social-emotional development (FEAS scores increased from 28.67 ± 9.34 to 35.31 ± 9.21, $p < .001$). Parental stress decreased significantly (PSI-SF scores from 94.89 ± 13.40 to 85.09 ± 12.43, $p < .001$). Provinces with fewer resources showed the greatest improvements, particularly among children under three years old. The THAI model represents a paradigm shift in early ASD intervention by decentralizing care to families and communities, empowering caregivers, and addressing disparities in access. This scalable, culturally adapted approach holds promise for reducing health inequalities in LMICs.

Introduction

Autism spectrum disorder (ASD) is a complex neurodevelopmental condition characterized by challenges in social communication, restricted and repetitive behaviors, and sensory sensitivities. It affects approximately 1 in 100 children globally, with rising prevalence attributed to increased awareness and improved diagnostic practices (Zeidan et al., 2022). Early intervention is critical in optimizing developmental outcomes for children with ASD, as evidence demonstrates that timely and intensive therapeutic approaches can significantly enhance cognitive, social, and language skills (Green et al., 2022; Zwaigenbaum et al., 2015). However, access to such interventions remains inequitable, particularly in low- and middle-income countries (LMICs), where resource constraints often limit availability and scalability of care (Divan et al., 2021; Lord et al., 2022) In LMICs, including Thailand, the traditional reliance on a medical model of care presents unique challenges for families of children with ASD (Sirithongthaworn et al., 2019) This model emphasizes specialist-driven, clinic-based services, which are not only resource -intensive but also often inaccessible to families

in rural and underserved areas (Divan et al., 2021; Haegele & Hodge, 2016) In Thailand, it is estimated that 85% of children with developmental delays do not receive adequate intervention services due to systemic barriers, including fragmented healthcare infrastructure, a shortage of trained professionals, and geographic disparities in access (Pavasuthipaisit et al., 2018; Sirithongthaworn et al., 2019). Families in rural provinces face additional financial and logistical challenges, further hindering their ability to access care. While the medical model is valuable for providing specialized interventions, its limitations in addressing large-scale needs have prompted calls for more family-centered approaches (McConkey, 2022). As a result, there has been growing interest in approaches that shift the focus from specialist -delivered treatment to caregiver-led support. This paradigm shift requires broadening the traditional specialist-driven model to integrate family-centered approaches, such as parent-mediated interventions (PMIs). PMIs empower caregivers to actively participate in their child's developmental progress by equipping them with evidence-based strategies that can be applied in everyday routines (Adams et al., 2013; Fuentes et al., 2021). This approach complements clinic-based services by extending therapeutic support into home and community settings, increasing accessibility and reducing dependence on limited specialist resources (Divan et al., 2021; Rahman et al., 2016). By shifting the focus from primarily clinic-based interventions to home - and community-based care, PMIs align with the need for scalable and sustainable solutions in resource -limited settings (Blake et al., 2017; Rahman et al., 2016). Emerging global evidence further supports the effectiveness of PMIs across diverse cultural and socioeconomic contexts. PMIs have been shown to improve developmental outcomes for children with ASD and reduce caregiver stress (Pajareya & Nopmaneejumruslers, 2011). Global initiatives such as the WHO Caregiver Skills Training (CST) program have demonstrated the feasibility and effectiveness of PMIs in diverse LMIC contexts, including India and Pakistan, improving caregiver–child interactions and reducing caregiver stress (Sengupta et al., 2023). These interventions are most impactful when culturally adapted, ensuring alignment with local practices, values, and resources (Blake et al., 2017; Rahman et al., 2016).

Uniqueness of the THAI Model

To address Thailand's specific structural and cultural challenges, the Thai Home-based Autism Intervention (THAI) model was developed as a culturally grounded PMI tailored for public-sector implementation. The model emerged from a five-year collaborative effort among Thai parents, therapists, and physicians to adapt Greenspan and Wieder's developmental and relationship-based principles (Greenspan & Wieder, 1998) into strategies suitable for Thai social norms and caregiving practices. These strategies were distilled into the I-CARE framework-Interaction, Comfort, Adapt, Respond, and Encouragement -making them accessible to caregivers with diverse educational backgrounds (National Institute for Child and Family Development, 2019). The THAI model embeds intervention naturally within daily routines, incorporates familiar cultural play themes, and accommodates multigenerational caregiving structures typical of Thai households. In addition, structured parent support groups aim to reduce stigma, foster resilience, and promote social inclusion, reflecting the central role of community support in Thai culture.

Comparison With Other Parent-Mediated Interventions

Global PMI such as the Parent-mediated Autism Social Skills (PASS) program (Rahman, 2016), the World Health Organization–Caregiver Skills Training (WHO CST) program (Sengupta, 2023), and the Parent-implemented Early Start Denver Model (P-ESDM) (Zhou, 2018) have demonstrated positive outcomes in improving caregiver–child interactions and early developmental skills. However, many require complex training, structured curricula, or proprietary methods that challenge scalability within LMIC public health systems. In contrast, the THAI model was intentionally designed for delivery within Thailand's universal health coverage framework using frontline health personnel. Its simplified, culturally anchored strategies, combined with community -embedded support structures, reduce barriers to adoption and sustain caregiver engagement across diverse contexts. By integrating family-centered practices into existing primary care services, the THAI

model aligns developmental support with the lived realities of Thai families while addressing systemic inequities in early ASD care. The study examines the model's impact on three primary outcomes: (1) caregiver-child interactions, (2) children's social-emotional development, and (3) parental stress. Additionally, the study explores variability in outcomes across provinces and subgroups to assess the model's scalability and adaptability. By addressing these objectives, this research contributes to the growing evidence base on PMIs and informs policy strategies for expanding equitable autism care in LMICs. Furthermore, it highlights the potential of family-centered, community-based interventions in bridging gaps in early intervention services in resource-limited settings.

Materials and Methods

The study protocol was reviewed and approved by the Mahidol University Central Institutional Review Board (MU-CIRB) (COA No. MU-CIRB 2020/004.0601). All participants provided written informed consent prior to enrollment, and participation was entirely voluntary.

Study Design

This study employed a quasi-experimental design to evaluate the effectiveness of the THAI model, a parent-mediated, play-based intervention for children with developmental delays (National Institute for Child and Family Development, 2019). The study was conducted in five provincial hospitals in Thailand from January to June 2020. These hospitals were selected based on their readiness and willingness to implement the program, and the intervention was integrated into routine services under universal health coverage.

Participants

Participants were recruited from five tertiary-care hospitals in Thailand using a multi-step sampling pathway designed to identify children at risk for developmental delays. Recruitment occurred through (a) hospital posters displayed in pediatric outpatient areas, and (b) referrals from pediatric nurses who screened children during routine well-child visits. The sample selection process included four stages: *(1)* **Initial Identification:** Pediatric nurses performed routine developmental surveillance and referred children aged 1–4 years who presented with suspected delays in expressive language or social functioning. *(2)* **Eligibility Screening:** Therapists at each hospital conducted standardized evaluations using predefined inclusion and exclusion criteria. Children were eligible if they were aged *1–4 years, failed the Thai developmental screening* in expressive language or social domains, were identified as at *risk for autism* using the Thai version of the Modified Checklist for Autism in Toddlers–Revised (M-CHAT-R) (Robins et al., 2014; Chaiudomsom et al., 2022), and had caregivers who agreed to provide *at least 10 hours per week* of play-based and developmental activities as part of routine care. Children were excluded if they had significant sensory or motor impairments or if their caregivers had major physical or psychiatric health problems that could interfere with their participation. (3) **Recruitment and Consent:** Families who met the criteria were approached by the project staff. The study objectives, procedures, expected time commitment, and potential risks were explained. Written informed consent was obtained from caregivers who voluntarily agreed to participate. (4) **Final Enrollment:** Because this project was designed as a pilot study, the sample size was determined based on feasibility and the number of eligible families identified during the study period. All families who met the inclusion criteria and provided consent during the recruitment window were included in the final sample. This systematic, stepwise pathway ensured consistency in participant selection and supported the feasibility focus of the pilot study.

Intervention: The THAI Model

The intervention comprised three core components aimed at empowering caregivers and enhancing child developmental outcomes over six months.

1. I-CARE Skills Coaching involved 12 in-clinic sessions conducted biweekly, each lasting approximately 60 minutes. Sessions were structured into three phases: rapport building (5–10 minutes) to address immediate caregiver concerns and goals; interactive playtime (40–45 minutes) during which therapists demonstrated and coached caregivers on I-CARE strategies (Table 4) —Interaction, Comfort, Adapt, Respond, and Encouragement—while engaging

with their child; and reflection and feedback (10–15 minutes) to discuss observations, adapt strategies, and set goals for home practice. Caregivers received tailored activity lists to reinforce I-CARE skills between sessions.

2. Support Groups were conducted every two months as 2–3 hour small-group sessions to foster a supportive community among caregivers. These sessions included relationship-building exercises to encourage openness, sharing of successes and challenges, viewing culturally adapted THAI Model videos: Parent-to-parent series (Mahidol Clinic, 2020), and reflection activities to process shared experiences. Caregivers were also provided online support through messaging applications for additional guidance and resources.

3. Home-based Activities emphasized the integration of I-CARE strategies into daily routines, aiming for at least 10 hours of focused interaction per week. Activities were tailored to the child's developmental needs, ranging from sensorimotor play for less -engaged children to pretend play for those with advanced interactive abilities (Mahidol Clinic, 2020; National Institute for Child and Family Development, 2019). Examples of activities included mealtime conversations, bath-time bonding, and play-based problem-solving to nurture social, emotional, and communicative skills.

Outcome Measures

Primary and secondary outcomes were assessed at baseline and post-intervention using standardized, validated tools.

1. The Functional Emotional Assessment Scale (FEAS) was used to evaluate children's social -emotional development across six functional emotional developmental levels, based on Greenspan and Wieder's framework (Greenspan & Wieder, 1998). Ratings range from 0 to 2 for each item, with higher scores indicating better performance, and the total score ranges from 0 to 66. The FEAS is widely used in developmental research and has demonstrated strong reliability, with an intraclass correlation coefficient (ICC) greater than 0.90 in previous studies (Greenspan et al., 2003). Although the tool is not formally validated in Thailand, its application in multiple studies within similar cultural contexts supports its suitability.

2. The I-CARE Assessment was developed by the research team to measure caregiver-child interaction across five domains: Interaction, Comfort, Adapt, Respond, and Encouragement (Maisook et al., 2019). Scores are categorized into four levels: poor (0–9), fair (10–15), good (16–24), and excellent (25–34). Content validity was assessed, yielding moderate -to-high ratings (Index of Content Validity: 0.67 –1.00) (Maisook et al., 2019). Interrater reliability was substantial, with an ICC of 0.84, indicating consistency across raters.

3. The Parenting Stress Index-Short Form (PSI-SF) is a self-report tool that assesses parental stress. It includes subscales for parental distress, parent -child dysfunctional interaction, and perceptions of difficult child behavior, with total scores ranging from 36 to 180. Scores of 90 or higher indicate clinically significant stress levels (Abidin, 1995). The PSI-SF is a validated instrument with strong psychometric properties. The Thai version of the PSI-SF has demonstrated high reliability, with a Cronbach's alpha of 0.88, and strong construct validity in prior studies (Srikosai et al., 2020).

Data analysis

Descriptive statistics were used to determine the frequencies, percentages, means, and standard deviations. Inferential statistics included paired t-tests for normally distributed data and Wilcoxon signed -rank tests for non-normally distributed data to compare the I-CARE, FEAS, and PSI scores before and after the THAI Model program. Cohen's d (effect size) was calculated to assess the magnitude of the mean differences, with d = 0.2, 0.5, and 0.8 representing small, medium, and large effects, respectively.

Results

Participant Characteristics

The study included 46 caregiver-child pairs, with caregivers primarily being parents (65.2%) and grandparents (32.6%) (Table 1). Most caregivers had an education level below high school (82.6%), and 34.8% reported a monthly income below USD 440. Children had an average age of 34.24 months, and 80.4% were male. Of the 46 enrolled caregiver–child pairs, FEAS and I-CARE analyses were available for

45 participants due to one unusable video recording. Provincial differences in population density, healthcare professional availability, and average monthly income are detailed in Table 2.

Table 1: Baseline child and family.

Characteristics	N (%) or Mean (Range, SD)
Child	
- Age	34.24 (18–50 months, SD 9.44)
- Male	37 (80.4%)
- Attend pre-school/daycare	18 (39.1%)
Family	
- Extended family	35 (76.1%)
Primary caregiver	
- Age	39.89 (18–75 years, SD 13.63)
- Parents	30 (65.2%)
- Grandparents	15 (32.6%)
- Stay-at-home caregivers	33 (71.73%)
- Stay-at-home caregivers	33 (71.73%)
- Primary caregiver's education, below 12th grade	
- Family Income	38 (82.6%)
- Less than 440 US $ / month	17 (34.8%)
- Between 440 and 880 US $ / month	26 (52.2%)

Table 2: Provincial Differences.

Provincial Differences	Population Density+	No. Health Professional ++	Family Income
Tak	39	9.85	485
Phetchabun	79	15.96	627
Chachoengsao	133	39.60	766
Nongkhai	172	44.36	622
Songkla	193	87.50	785

+ Population Density: People per square kilometre.
++ Number of healthcare professionals per 100 sq. km.
*** Provincial Family income per month (Average in Thailand: $791 USD, Range: $396–$1,340 USD)*
Note. Adapted from Statistical Yearbook Thailand 2020, by National Statistical Office, Ministry of Digital Economy and Society (2020).

Parent-Child Interacion

Post-intervention, total I-CARE scores increased significantly from 12.69 ± 5.08 to 16.60 ± 6.45 ($p < .001$), and an improvement from a fair (10-15) to a good (16-24) level (Table 3). Subscale improvements were observed across "Interaction," "Comfort," "Adapt," "Respond," and "Encouragement," with the largest effect in the "Adapt" domain (Details are provided in Table 4).

Table 3: Parent and child outcomes+ (Total score).

THAI Model Outcome	Pre-intervention		Post-intervention		*t-test*	*p-value*	Effect size (Cohen's d)
	M	SD	M	SD			
I-CARE	12.69	5.08	16.60	6.45	-4.85	.000*	0.72
FEAS	28.67	9.34	35.31	9.21	-5.68	.000*	0.84
PSI	94.89	13.4	85.09	12.43	6.01	.000*	0.89

*I-CARE: Interaction (I), Comfort (C), Adapt (A), Read and Respond (R), and Encouragement (E); FEAS: Functional Emotional Assessment Scale; PSI, Parental Stress Index; * p < .05.*

Children's Social-Emotional Development

Children's FEAS scores improved significantly from 28.67 ± 9.34 to 35.31 ± 9.21 (p < .001; Table 3). The effect size of the total score was 0.84, which indicates a larger effect size. In the subscale analysis, the "Engagement" subscale demonstrated the greatest improvement, with a mean increase of 3.0 points (Table 4).

Parental Stress

PSI-SF scores decreased significantly from 94.89 ± 13.40 to 85.09 ± 12.43 post-intervention (p < .001; Table 3). In subscale analysis, the greatest reductions were observed in the "Parent-Child Dysfunctional Interaction" (p < .001; Table 4).

Table 4: Parent and child outcomes (overall).

THAI Model Outcome	Pre-intervention		Post-intervention		*t-test*	*p-value*	Effect size (Cohen's d)
	M	SD	M	SD			
I-CARE	12.69	5.08	16.60	6.45	-4.85	.000*	0.72
- Interaction (I)	3.53	1.88	4.60	1.93	-3.45	.001*	0.51
- Comfort (C)	2.33	0.74	2.80	1.01	-3.32	.002*	0.49
- Adapt (A)	2.11	1.02	2.93	1.11	-5.36	.000*	0.80
- Respond (R)	2.24	1.72	3.29	2.04	-3.57	.001*	0.53
- Encouragement (E)	2.44	0.84	2.98	1.23	-3.14	.003*	0.47
FEAS	28.67	9.34	35.31	9.21	-5.68	.000*	0.84
- Shared attention	12.22	2.90	13.16	2.08	-2.34	.024*	0.37
- Engagement	9.76	3.86	12.76	3.28	-5.33	.000*	0.83
- Two-way interaction	5.38	2.33	6.31	2.52	-3.00	.004*	0.38
- Complex communication	0.57	0.69	0.95	0.96	-3.04	.004*	0.45
- Language and symbolic play	0.92	2.14	2.28	2.22	-4.29	.000*	0.62
- Logical thinking	0.04	0.21	0.09	0.41	-1.00	.328	0.15
PSI	94.89	13.4	85.09	12.43	6.01	.000*	0.89
- Parental distress	33.00	6.79	29.91	6.36	4.19	.000*	0.46
- PCDI	31.02	5.25	27.43	4.61	4.52	.000*	0.72
- Difficult child	30.87	5.77	27.72	5.21	4.64*	.000	0.57

*FEAS: Functional Emotional Assessment Scale; I-CARE: Interaction (I), Comfort (C), Adapt (A), Read and Respond (R), and Encouragement (E); PSI, Parental Stress Index; PCDI, Parent-Child Dysfunctional Interaction; * p < .05.*

Provincial Trends in Intervention Outcomes

The intervention's effectiveness varied across provinces (see Table 5). Distinct findings were observed in Tak and Songkhla. In Tak, a low-resource province, significant improvements were seen in parent-child interaction and child outcomes (FEAS, p = 0.012; I-CARE, p = 0.028), but no notable reduction in parental stress (p = 0.141). In contrast, Songkhla, with higher income and better healthcare access, showed significant reductions in parental stress (p = 0.007) but no significant gains in parent-child interaction or child outcomes (FEAS, p = 0.054; I-CARE, p = 0.075).

Table 5: Parent and child outcomes by province.

	Province	n	Pre Mdn (Q3-Q1)	Post Mdn (Q3-Q1)	Z	p-value
FEAS	Tak	8	26.00 (35.00–16.50)	36.50 (43.75–22.00)	-2.524	0.012*
	Phetchabun	12	26.00 (32.00–24.25)	36.50 (45.00–28.00)	-2.08	0.037*
	Nong Khai	5	19.00 (30.50–12.00)	24.00 (38.00–21.00)	-2.023	0.043*
	Chachoengsao	8+	36.50 (42.75–20.50)	39.50 (46.25–36.00)	-1.970	0.049*
	Songkhla	12	34.50 (37.00–25.75)	36.00 (39.75–31.25)	-1.926	0.054
I-CARE	Tak	8	15.00 (17.75–10.25)	19.00 (26.50–14.00)	-2.201	0.028*
	Phetchabun	12	12.50 (17.75–10.25)	17.00 (20.75–13.25)	-1.887	0.059
	Nong Khai	5	15.00 (17.50–11.50)	23.00 (25.00–19.00)	-2.032	0.042*
	Chachoengsao	8+	9.00 (17.25–6.25)	12.50 (17.25–8.00)	-1.156	0.248
	Songkhla	12	9.50 (13.75–7.25)	14.00 (17.25–10.00)	-1.783	0.075
PSI	Tak	8	90.50 (104.00–78.25)	81.50 (86.00–77.50)	-1.472	0.141
	Phetchabun	12	97.00 (106.25–89.75)	84.00 (88.75–77.00)	-3.062	0.002*
	Nong Khai	5	90.00 (110.00–84.50)	80.00 (117.00-74.50)	-0.674	0.500
	Chachoengsao	9	88.00 (101.00–84.50)	83.00 (90.50–68.00)	-2.194	0.028*
	Songkhla	12	95.50 (103.75–89.75)	90.50 (97.25–87.00)	-2.710	0.007*

*FEAS: Functional Emotional Assessment Scale; I-CARE: Interaction (I), Comfort (C), Adapt (A), Read and Respond (R), Encouragement (E); PSI: Parental Stress Index; + One missing data point due to a video error. (Total FEAS and I-CARE analyses were conducted for 45 participants.) * p < .05*

Intervention Outcomes Across Age Groups

Caregivers of children under 3 years showed greater improvements in parent-child interaction, as measured by I-CARE (p = 0.043; Table 6). In contrast, FEAS scores revealed no significant differences between age groups before or after the program (p > 0.05 Table 6).

Table 6: Pre-and post- scores of differences in FEAS and I-CARE between children aged 0 to 36 months and more than 36 months.

Measure		0 to 36 months (n = 24)		Post-intervention (n = 21)		*df*	*t*	p
		M	SD	M	SD			
FEAS	Pretest	28.71	8.65	28.62	10.29	43	.032	.957
	Posttest	35.88	9.87	34.67	8.59	43	.435	.666
I-CARE	Pretest	14.04	5.38	11.14	4.34	43	1.96	.055
	Posttest	18.38	7.12	14.57	4.99	43	2.093	.043

Discussion

This study provides preliminary evidence supporting the potential effectiveness of the THAI model, a parent-mediated, play-based intervention, in improving parent-child interactions, reducing parental stress, and fostering the social-emotional development of young children with or at risk for autism. While these results are encouraging, they should be interpreted with caution due to the absence of a control group. Nevertheless, the intervention's apparent success in resource-limited settings highlights its adaptability and potential relevance for low- and middle-income countries (LMICs). These findings contribute to ongoing global efforts to address health inequities by developing scalable, culturally adaptable interventions that support families in diverse contexts (Divan et al., 2021; Lord et al., 2022; Rahman et al., 2016).

Overview of Key Findings

The THAI model demonstrated significant improvements in parent-child interactions, reductions in parental stress, and enhanced social-emotional development among participating children. These outcomes underscore the potential of culturally tailored interventions in addressing developmental needs across diverse socioeconomic settings (Blake et al., 2017; McConkey, 2022). Younger children showed notably greater gains in parent-child interactions, consistent with evidence on neuroplasticity and the advantages of early developmental interventions (Green et al., 2022; Zwaigenbaum et al., 2015). These findings emphasize the importance of initiating parent-mediated interventions (PMIs) during early childhood to maximize developmental outcomes (Green et al., 2022; Lord et al., 2022).

Comparison With Other Global PMIs:

Developmental gain in rural area

The developmental improvements in rural provinces such as Tak mirror patterns found in other LMIC PMI trials. Studies from South Asia and Bangladesh have shown that caregivers who spend more time at home can consistently implement play-based strategies, leading to strong developmental gains (Rahman et al., 2016; Blake et al., 2017). However, the limited reductions in parental stress in these regions echo findings from similar LMIC contexts, suggesting that socioeconomic instability, financial strain, caregiving burden, and limited digital access can constrain improvements in caregiver well-being even when child outcomes improve. The THAI model's results, therefore, reflect both the potential and the contextual limitations of PMI implementation in underserved areas.

Role of Parent Support Groups

Parent support groups emerged as a cornerstone of the THAI model, offering caregivers emotional support, reducing stigma, and fostering a sense of community. These groups provided opportunities for shared learning, practical skill-building, and mutual encouragement, which were instrumental in reducing caregiver stress levels (Blake et al., 2017; Maisook et al., 2019). These findings align with the WHO Caregiver Skills Training Program (WHO-CST) in India, a PMI that incorporated a parent group as a key intervention strategy and similarly reported significant reductions in parental stress (Sengupta et al., 2023). In contrast, programs in China (Zhou et al., 2018) and South Africa (Rieder et al., 2023), which lacked a parent group component, demonstrated less substantial reductions in parental stress, suggesting the potential importance of this feature (Rieder et al., 2023; Zhou et al., 2018). These results reaffirm that including parent groups is an essential addition to PMIs, particularly in LMICs, where they address stigma, promote resilience, and reduce social isolation (Blake et al., 2017; Lee et al., 2022; Lee et al., 2024).

Implications for Practice and Scalability

The findings underscore the importance of understanding how socioeconomic and cultural differences influence the outcomes of PMIs. As highlighted by Trembath et al. (2019), the success and scalability of PMIs depend heavily on contextual factors. For instance, the intervention's ability to reduce parental stress in urban Songkhla demonstrates its value even in high-resource settings. Policymakers in LMICs are encouraged to adapt PMIs to local cultural and contextual needs by leveraging community health workers, utilizing digital tools for remote access, and embedding interventions within primary care frameworks. Future research should explore the potential of telemedicine and mobile applications to extend the model's reach and evaluate its cost-effectiveness and sustainability in improving long-term outcomes.

Challenges and Future Directions

The absence of a control group limits the ability to attribute observed improvements solely to the intervention. Additionally, variability in outcomes across provinces may reflect differences in implementation fidelity and resource availability. The relatively small sample size restricts the generalizability of findings, underscoring the need for larger, more robust studies to validate these results. Future research should prioritize randomized controlled trials and expand to include diverse geographical and cultural settings to enhance the model's generalizability. Furthermore, integrating complementary mental health support and social services could holistically address caregiver well-being, particularly in underserved areas like Tak and

Nong Khai, where compounding challenges such as financial instability and high caregiving demands persist.

Conclusion

The THAI model is a scalable, culturally adapted intervention that reduces health inequalities in autism care by empowering caregivers and shifting services to community and home-based settings. It bridges gaps in early intervention access, particularly in underserved areas, and aligns with global efforts to address health disparities. By decentralizing services and embedding interventions within primary care frameworks, the model ensures equitable access to high-quality care. These findings highlight the importance of family-centered approaches in overcoming systemic barriers and promoting developmental equity in LMICs.

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Data Availability Statement

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request, subject to approval by the relevant institutional review board and data use agreement to ensure protection of participant confidentiality.

Declarations

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Conflict of Interest

The authors declare no conflict of interest related to this study.

Registration number of clinical trial

None.

Author Contributions

Kaewta Nopmaneejumruslers (KN): Conceptualization, Methodology, Supervision, Writing – Review & Editing, Essentially Intellectual Contributor. Thanayot Sumalrot (TS2): Methodology, Formal Analysis, Data Interpretation, Writing – Original Draft, Corresponding Author. Tamara Sumalrot (TS1): Methodology, Investigation, Data Curation, Formal Analysis, Writing – Original Draft, First Author. Prapa Maisook (PM): Methodology, Investigation, Data Curation, Writing – Review & Editing. Koonthaleeporn Srijun (KS): Methodology, Investigation, Data Curation, Writing – Review & Editing. All authors have read and approved the final version of the manuscript.

Use of artificial intelligence

ChatGPT (OpenAI) was used to assist with grammar checking and language refinement; all content was reviewed and verified for accuracy and appropriateness by the authors.

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