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RESEARCH ARTICLE

BRIDGING HEALTH POLICY AND PRACTICE: THE MEDIATING ROLE OF THE CHILD HEALTH AND INTEGRATED POLICY SYSTEM (CHIPS) IN PREVENTING PEDIATRIC PULPITIS IN INDONESIA

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ABSTRACT

OBJECTIVE:

To examine the mediating role of the Child Health and Integrated Policy System (CHIPS) in linking cross-sectoral collaboration and cross-program integration with pediatric pulpitis incidence in Kendari City, Indonesia.

DESIGN:

A cross-sectional quantitative study using Partial Least Squares Structural Equation Modeling (PLS-SEM).
Setting: Fifteen public primary healthcare centers (puskesmas) in Kendari City, Southeast Sulawesi Province, Indonesia.
Main outcome measures: Pediatric pulpitis incidence among children aged 6–12 years, obtained from facility-level administrative health records from 2022 to 2024.

RESULTS:

Cross-sectoral collaboration was positively associated with CHIPS functionality ($\beta = 0.634$, $p < 0.001$), while cross-program integration also showed a significant positive association with CHIPS functionality ($\beta = 0.306$, $p = 0.001$). CHIPS functionality was negatively associated with the incidence of pediatric pulpitis ($\beta = –0.667$, $p < 0.001$). Mediation analysis showed that CHIPS fully mediated the relationship between cross-sectoral collaboration and pediatric pulpitis incidence (indirect $\beta = –0.422$, $p < 0.001$) and partially mediated the relationship between cross-program integration and pediatric pulpitis incidence (indirect $\beta = –0.204$, $p = 0.004$).

CONCLUSIONS:

CHIPS may serve as an important integrated governance mechanism linking collaborative policy implementation to reduced pediatric pulpitis incidence. Strengthening intersectoral coordination, program integration, and facility-level data systems may improve the effectiveness of pediatric oral health prevention within municipal primary healthcare systems.

KEYWORDS

Child oral health policy; integrated governance; pediatric pulpitis; intersectoral collaboration; health systems

INTRODUCTION

Oral health during childhood is a fundamental component of overall health and development, influencing nutrition, communication, psychological well-being, school participation, and long-term quality of life [1]. Among pediatric oral diseases, dental caries remains one of the most prevalent chronic conditions worldwide and frequently progresses to pulpitis when left untreated [2]. Pediatric pulpitis is characterized by inflammation of the dental pulp, primarily caused by untreated carious lesions and bacterial infection. The condition is often associated with severe pain, eating difficulties, sleep disturbances, impaired concentration, and increased risk of systemic infection in children. If not appropriately managed, pulpitis may contribute to poor nutritional status, reduced educational performance, and diminished psychosocial well-being during critical stages of child development [3].

Globally, the World Health Organization (WHO) estimates that approximately 60–90% of school-aged children experience dental caries, with a substantial proportion progressing to advanced oral conditions requiring urgent treatment [4]. The burden is particularly pronounced in low- and middle-income countries (LMICs), where limitations in preventive oral healthcare, delayed treatment seeking, and unequal service access continue to exacerbate child oral health disparities. In Southeast Asia, dental caries prevalence among children remains among the highest globally, reflecting persistent structural and behavioral challenges in oral health prevention and service delivery [5]. In Indonesia, national surveys have consistently reported high rates of untreated dental problems among school-aged children, especially in urban and socioeconomically vulnerable populations. Pediatric pulpitis has therefore emerged not only as a clinical issue but also as a public health and health governance concern requiring coordinated multisectoral intervention[6].

Despite the implementation of several child-focused health initiatives in Indonesia, including the School Dental Health Program (Usaha Kesehatan Gigi Sekolah [UKGS]), maternal and child health services, nutritional interventions, and school-based health promotion activities, program implementation frequently remains fragmented across sectors and institutions[7]. In many settings, limited coordination between healthcare providers, schools, social services, and local government agencies contributes to inconsistent prevention strategies, duplication of activities, weak monitoring systems, and unequal access to oral healthcare services. These structural limitations reduce the effectiveness of early prevention and continuity of care for children at risk of oral disease[8].

Recent public health governance literature increasingly emphasizes the importance of intersectoral collaboration and integrated policy systems in addressing complex health challenges affecting children [9]. Integrated governance approaches are considered particularly important in LMIC contexts, where healthcare fragmentation, resource constraints, and institutional silos often undermine service effectiveness [10]. Within this context, the Child Health and Integrated Policy System (CHIPS) has emerged as a collaborative governance framework to strengthen coordination among child-focused sectors through integrated planning, data sharing, policy alignment, and collaborative service delivery. CHIPS seeks to promote continuity of care and improve policy coherence by linking oral health, maternal and child health, nutrition, education, and community health initiatives within a unified governance structure[3].

From a theoretical perspective, this study is informed by the principles of Collaborative Governance and Integrative Policy Design, which propose that complex public health problems are more effectively addressed through coordinated multisectoral action rather than isolated sector-specific interventions[11]. Previous studies have demonstrated that integrated governance mechanisms can improve service accessibility, enhance policy efficiency, and strengthen accountability within child health systems [12]. However, empirical applications of these governance frameworks within pediatric oral health remain limited, particularly in LMIC settings where institutional integration challenges are more pronounced.

Although previous research has examined school-based oral health programs, preventive dental services, and child healthcare outreach initiatives, limited attention has been paid to the governance mechanisms that link intersectoral collaboration to measurable pediatric oral health outcomes [2]. Furthermore, few studies have quantitatively examined

how integrated governance systems mediate the relationship between collaborative policy implementation and child oral health performance. This gap remains especially evident in the Indonesian context, where evidence on integrated oral health governance remains underdeveloped.

Methodologically, this study also contributes to the growing application of Partial Least Squares Structural Equation Modeling (PLS-SEM) in health governance research. While PLS-SEM has been widely used in organizational and social science research, its application in pediatric oral health governance research remains relatively limited. The use of PLS-SEM in this study enables the examination of complex relationships among governance constructs and institutional health outcomes while simultaneously assessing the mediating role of CHIPS within an integrated policy framework

Therefore, this study aims to examine the mediating role of CHIPS in linking cross-sectoral collaboration and cross-program integration with pediatric pulpitis incidence in Kendari City, Indonesia. By integrating governance perspectives with pediatric oral health outcomes, this study contributes to the broader discussion on integrated child health systems and collaborative governance in LMIC settings.

METHODS

STUDY DESIGN

This study employed a cross-sectional quantitative design to examine the mediating role of the Child Health and Integrated Policy System (CHIPS) in the relationship between intersectoral collaboration and pediatric pulpitis incidence. A deductive approach was adopted to test the hypothesized model. Partial Least Squares Structural Equation Modeling (PLS-SEM) was selected due to its suitability for testing complex relationships among latent variables and its robustness in studies with relatively small sample sizes.

STUDY SITE AND PARTICIPANTS

The study was conducted in Kendari City, Southeast Sulawesi Province, Indonesia, covering all 15 public primary health care centers (*puskesmas*). These facilities represent the frontline providers of integrated child and dental health services. A total of 84 health workers were recruited through stratified random sampling to ensure representation across professional categories, including physicians, dentists, program coordinators, and public health officers involved in child health programs.

INSTRUMENTS

Data were collected through a structured questionnaire developed from prior validated instruments and adapted to the Indonesian context. The questionnaire underwent expert review and pilot testing to ensure validity and reliability. It consisted of four constructs: Cross-Sectoral Collaboration (10 items), Cross-Program Integration (8 items), CHIPS Functionality (12 items), and Pulpitis Case Records. All items, except case records, were rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Pediatric pulpitis case data (ages 6–12 years) were obtained retrospectively from health records between 2022 and 2024, and cross-verified by program managers at each ***puskesmas***.

VARIABLES AND MEASURES

Independent Variables: Cross-Sectoral Collaboration is defined as the degree of inter-agency coordination involving the health, education, nutrition, and social services sectors. Cross-Program Integration refers to the alignment and synchronization between different child-focused programs such as UKGS, MCH, and school health initiatives. Mediating Variable: CHIPS operationalized as a multidimensional construct involving data integration, policy alignment, and functional coordination platforms at the primary care level.

Dependent Variable: Pulpitis Incidence, measured as the number of new pediatric pulpitis cases reported at each puskesmas during 2022–2024.

DATA ANALYSIS

The primary analytical technique was Partial Least Squares Structural Equation Modeling (PLS-SEM), implemented in SmartPLS version 4.0. The following steps were undertaken:

1. Outer Model Evaluation – convergent validity (loading > 0.70), Average Variance Extracted(AVE > 0.5), and Composite Reliability (CR > 0.7).
2. Inner Model Evaluation – assessing path coefficients, significance (bootstrapping with 5000 samples), and the R^2 value of the endogenous construct.
3. Mediation Testing indirect effects were assessed using the variance accounted for (VAF) criterion and the Sobel test for mediation.

Descriptive statistics were also generated in SPSS 25.0 to analyze participant characteristics and case trends over time. A graphical trend of pulpitis cases was presented to complement the inferential findings.

ETHICS CLEARANCE

This study adhered to the ethical principles outlined by the National Health and Medical Research Council (NHMRC) and relevant Indonesian regulations on research involving human participants. Ethical approval for this study was obtained from the Research Ethics Committee of Universitas Mandala Waluya, with clearance number:066/KEP-UMW/VII/2025

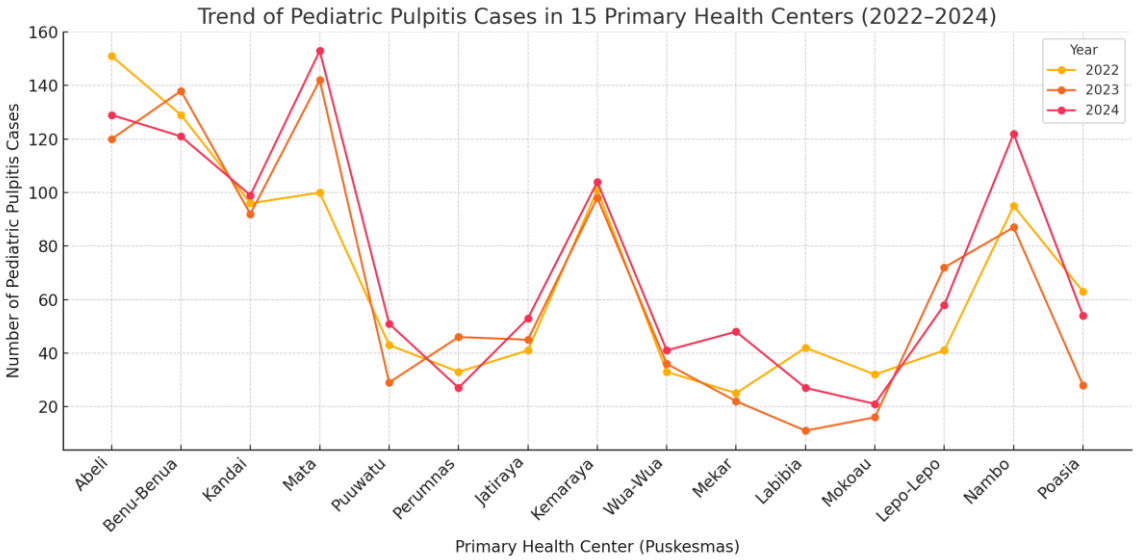
RESULTS

This section presents the descriptive and inferential results of the study. Descriptive statistics summarize the distribution of pediatric pulpitis cases reported by 15 public health centers (puskesmas) in Kendari City over a three-year period (2022–2024), while inferential analysis tests the hypothesized relationships using PLS-SEM.

TREND OF PEDIATRIC PULPITIS CASES (2022–2024)

Figure 1 shows the trend of pediatric pulpitis cases reported across the 15 puskesmas. Some centers, such as Mata, Poasia, and Kemaraya, consistently recorded higher case numbers over the three years, indicating localized service or awareness gaps. In contrast, facilities like Labibia and Mokoau reported relatively lower figures, suggesting either lower incidence or potential underreporting. Notably, the fluctuations observed in most centers suggest varying degrees of policy implementation effectiveness and public awareness.

FIGURE 1. TREND OF PEDIATRIC PULPITIS CASES IN 15 PUBLIC HEALTH CENTERS IN KENDARI CITY (2022–2024)



The analysis revealed several significant relationships between cross-sectoral and cross-program cooperation, the Child Health and Integrated Policy System (CHIPS), and the incidence of pulpitis in children. The key findings are as follows:

MEASUREMENT MODEL EVALUATION

The measurement model was assessed to determine the reliability and validity of the latent constructs. All constructs demonstrated acceptable indicator reliability, with outer loading values exceeding the recommended threshold of 0.70. Convergent validity was confirmed because all Average Variance Extracted (AVE) values were above 0.50. Internal consistency reliability was also satisfactory, as Composite Reliability and Cronbach's alpha values exceeded 0.70 for all constructs.

Discriminant validity was assessed using the Heterotrait–Monotrait Ratio (HTMT). All HTMT values were below 0.90, indicating that the constructs were empirically distinct.

TABLE 1. MEASUREMENT MODEL ASSESSMENT

Construct	No. of Indicators	Outer Loading Range	AVE	Composite Reliability	Cronbach's Alpha
Cross-Sectoral Collaboration	10	0.721–0.884	0.641	0.921	0.907
Cross-Program Integration	8	0.708–0.861	0.617	0.903	0.887
CHIPS Functionality	12	0.734–0.901	0.673	0.938	0.926
Pediatric Pulpitis Incidence	3	0.701–0.846	0.592	0.812	0.754

TABLE 2. DISCRIMINANT VALIDITY ASSESSMENT USING HTMT

Construct	Cross-Sectoral Collaboration	Cross-Program Integration	CHIPS Functionality	Pediatric Pulpitis Incidence
Cross-Sectoral Collaboration	—			
Cross-Program Integration	0.742	—		
CHIPS Functionality	0.781	0.694	—	
Pediatric Pulpitis Incidence	0.431	0.486	0.632	—

STRUCTURAL MODEL EVALUATION

The structural model was evaluated using bootstrapping with 5,000 resamples. The results showed that cross-sectoral collaboration was positively associated with CHIPS functionality ($\beta = 0.634$, $t = 7.842$, $p < 0.001$). This finding indicates that stronger collaboration among health, education, social, and local government sectors was associated with stronger CHIPS functionality.

Cross-program integration also showed a positive association with CHIPS functionality ($\beta = 0.306$, $t = 3.974$, $p = 0.001$), suggesting that better alignment among child health, nutrition, school health, and maternal-child health programs was associated with stronger integrated governance.

CHIPS functionality was negatively associated with the incidence of pediatric pulpitis ($\beta = –0.667$, $t = 8.115$, $p < 0.001$). This indicates that stronger integrated governance was associated with a lower reported incidence of pediatric pulpitis across healthcare facilities.

The direct relationship between cross-sectoral collaboration and pediatric pulpitis incidence was not statistically significant ($\beta = 0.048$, $t = 0.721$, $p = 0.472$). In contrast, cross-program integration showed a significant negative direct association with pediatric pulpitis incidence ($\beta = –0.236$, $t = 2.214$, $p = 0.028$).

TABLE 3. STRUCTURAL MODEL RESULTS

Hypothesized Path	β	t-value	p-value	Result
Cross-Sectoral Collaboration → CHIPS Functionality	0.634	7.842	<0.001	Supported
Cross-Program Integration → CHIPS Functionality	0.306	3.974	0.001	Supported
CHIPS Functionality → Pediatric Pulpitis Incidence	–0.667	8.115	<0.001	Supported
Cross-Sectoral Collaboration → Pediatric Pulpitis Incidence	0.048	0.721	0.472	Not supported
Cross-Program Integration → Pediatric Pulpitis Incidence	–0.236	2.214	0.028	Supported

EXPLANATORY AND PREDICTIVE POWER

The coefficient of determination indicated that the model explained a substantial proportion of variance in CHIPS functionality and pediatric pulpitis incidence. The R^2 value for CHIPS functionality indicated that cross-sectoral collaboration and cross-program integration jointly explained meaningful variation in CHIPS functionality. The R^2 value for pediatric pulpitis incidence indicated that CHIPS functionality and collaborative governance variables contributed to explaining variation in reported pediatric pulpitis incidence.

Predictive relevance was assessed using Q^2 values. The Q^2 values were above zero, indicating acceptable predictive relevance of the model.

TABLE 4. EXPLANATORY AND PREDICTIVE POWER OF THE STRUCTURAL MODEL

Endogenous Construct	R^2	Adjusted R^2	Q^2
CHIPS Functionality	0.721	0.714	0.526
Pediatric Pulpitis Incidence	0.604	0.591	0.438

EFFECT SIZE ASSESSMENT

Effect size analysis was conducted using f^2 values to determine the relative contribution of each predictor to the endogenous constructs. Cross-sectoral collaboration showed a large effect on CHIPS functionality, while cross-program integration demonstrated a moderate effect. CHIPS functionality showed a large effect on pediatric pulpitis incidence. Cross-sectoral collaboration had a negligible direct effect on pediatric pulpitis incidence, whereas cross-program integration showed a small direct effect.

TABLE 5. EFFECT SIZE ASSESSMENT

Path	f^2	Interpretation
Cross-Sectoral Collaboration → CHIPS Functionality	0.512	Large
Cross-Program Integration → CHIPS Functionality	0.184	Medium
CHIPS Functionality → Pediatric Pulpitis Incidence	0.647	Large
Cross-Sectoral Collaboration → Pediatric Pulpitis Incidence	0.006	Negligible
Cross-Program Integration → Pediatric Pulpitis Incidence	0.061	Small

MEDIATION ANALYSIS

The mediating role of CHIPS functionality was assessed using bootstrapped indirect effect analysis. The indirect pathway from cross-sectoral collaboration to pediatric pulpitis incidence through CHIPS functionality was statistically significant and negative ($\beta = -0.422$, $p < 0.001$). Because the direct relationship between cross-sectoral collaboration and pediatric pulpitis incidence was not statistically significant, CHIPS functionality was interpreted as fully mediating this relationship.

The indirect pathway from cross-program integration to pediatric pulpitis incidence through CHIPS functionality was also

statistically significant and negative (β = –0.204, p = 0.004). Because the direct relationship between cross-program integration and pediatric pulpitis incidence remained statistically significant, CHIPS functionality was interpreted as partially mediating this relationship.

TABLE 6. MEDIATION EFFECTS OF CHIPS FUNCTIONALITY

Relationship	Direct Effect β	Indirect Effect β	p-value	Mediation Type
Cross-Sectoral Collaboration → CHIPS → Pediatric Pulpitis Incidence	0.048	–0.422	<0.001	Full mediation
Cross-Program Integration → CHIPS → Pediatric Pulpitis Incidence	–0.236	–0.204	0.004	Partial mediation

Overall, the findings indicate that CHIPS functionality serves as an important governance mechanism that links collaborative policy implementation to lower pediatric pulpitis incidence. The results also suggest that cross-sectoral collaboration may operate primarily through CHIPS functionality, whereas cross-program integration may have both direct and indirect associations with pediatric pulpitis incidence.

DISCUSSION

The present study demonstrates that the Child Health and Integrated Policy System (CHIPS) plays a pivotal mediating role in translating intersectoral and interprogram collaboration into improved pediatric oral health outcomes. Specifically, CHIPS significantly reduced the incidence of pediatric pulpitis when cross-sectoral and cross-program policies were aligned and operationalized through integrated governance mechanisms[13]. This finding underscores the importance of institutionalizing CHIPS as a governance framework to address systemic fragmentation and inequities in child health service delivery.

These findings are consistent with global evidence emphasizing the value of integrated governance approaches in child health. Prior studies in low- and middle-income countries (LMICs) have highlighted that fragmented programs often fail to achieve sustainable health outcomes unless coordinated through multisectoral platforms[14]. Our results confirm that collaboration among the health, education, and social service sectors strengthens CHIPS functionality, echoing research in Southeast Asia showing that inter-agency partnerships improve access to and utilization of oral health services. Furthermore, the strong mediating effect of CHIPS aligns with the "whole-of-government" perspective in public health governance, which argues that policy coherence and integrated service delivery are essential to overcome resource and infrastructure constraints [15].

From a theoretical standpoint, this study extends the application of Collaborative Governance and Integrative Policy Design to pediatric oral health. While these frameworks have been widely applied in broader health policy, their empirical testing in oral health governance has been limited. By employing Partial Least Squares Structural Equation Modeling (PLS-SEM), this study provides methodological innovation, demonstrating how governance mechanisms can be quantitatively modeled as mediators of health outcomes. This helps bridge a critical gap in the literature, where governance constructs are often discussed conceptually but rarely operationalized in empirical models[16].

One key dimension revealed in this study is the centrality of health information systems within CHIPS. Reliable, timely data were shown to strengthen policy alignment and improve resource allocation for oral health interventions. This aligns with recent global discussions on digital health governance, which emphasize that integrated data systems are not merely technical tools but foundational elements of policy coherence and accountability. The study, therefore, highlights the need to invest in digital reporting platforms and standardized monitoring mechanisms to enhance the functionality of CHIPS across diverse healthcare settings[17].

The findings also highlight equity in access to pediatric oral health services. The observed disparities in pulpitis incidence across *puskesmas* underscore how local variations in service availability and outreach capacity can perpetuate inequalities. Similar patterns have been documented in other LMICs, where urban-rural divides and socioeconomic status influence child oral health outcomes[11]. Strengthening CHIPS provides an opportunity to embed equity considerations into governance structures, ensuring that vulnerable groups, particularly children in underserved communities, receive timely, high-quality care.

In addition, the study contributes to the global agenda for child health governance by situating oral health within broader frameworks of multisectoral collaboration. The United Nations Sustainable Development Goals (SDGs), particularly Goal 3 (Good Health and Well-being), call for integrated approaches to child health. By empirically demonstrating how CHIPS mediates collaboration and outcomes, this research offers evidence that governance innovations in Indonesia can inform global debates on child health policy integration. This reinforces the notion that oral health should not be addressed in isolation but rather integrated into the wider child health and development agenda [3].

In terms of practical implications, the findings highlight several policy priorities. First, institutionalizing CHIPS at the municipal and district levels can ensure sustained policy coherence and accountability across sectors. Second, strengthening school-based and community outreach programs is vital for addressing behavioral and environmental risk factors associated with pediatric pulpitis. Third, improving the timeliness and accuracy of health data reporting can enhance decision-making and resource allocation. Lastly, joint training initiatives for health workers across child programs can foster collaborative practices and reduce programmatic silos. Together, these strategies have the potential to advance equitable access and quality of oral health services for children.

Despite its contributions, the study is not without limitations. The cross-sectional design restricts causal inference, limiting the ability to capture long-term effects of CHIPS implementation. The reliance on administrative records raises potential concerns regarding data accuracy and reporting consistency across *puskesmas*. Furthermore, the study was confined to a single urban setting in Southeast Sulawesi, which limits the generalizability of findings to rural or culturally diverse populations. Addressing these limitations will require longitudinal designs, triangulation with qualitative data, and broader geographic coverage in future research.

Future investigations should explore contextual enablers and barriers to CHIPS implementation using mixed methods approaches. Comparative studies across rural and urban areas would be valuable to understand equity dimensions, while longitudinal evaluations could provide stronger evidence of causality. Additionally, integrating patient and community perspectives into governance assessments may offer insights into how cultural and behavioral factors influence the effectiveness of CHIPS.

CONCLUSION

The findings demonstrate that CHIPS functions as a strategic governance mechanism to harmonize service delivery, integrate data systems, and align policy objectives across child health programs. While variations in case numbers across health centers persist, institutionalizing CHIPS within municipal and district health systems, supported by accurate data reporting and collaborative capacity building, is critical to improving equity and quality of care. This study contributes to the growing evidence on governance innovations in child health and highlights the importance of context-sensitive strategies. Future research should extend to rural areas and employ mixed methods to capture the structural and behavioral determinants influencing CHIPS implementation and sustainability.

DECLARATIONS

All authors have approved the final version of the manuscript and agree to its submission.
There are no conflicts of interest to declare.

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