

Beyond Community Nutrition Services: A Conceptual Analysis of the Posyandu Ecosystem, Cadre Capacity, and the Paradox of Iron Supplement Adherence

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ABSTRACT

Community-based health and nutrition services in Indonesia continue to face complex challenges, particularly regarding the quality of Posyandu services, cadre capacity, and adherence to iron supplementation among adolescent girls. This article aims to analyze the relationships among the quality of the Posyandu ecosystem, cadre capacity, and adherence to iron supplementation as three important components of effective community nutrition services. Unlike a fully empirical mixed-methods study, this article employed a document-based conceptual analysis involving thematic interpretation and descriptive quantitative elaboration. The numerical data presented in the results were positioned as analytical simulations intended to clarify patterns of relationships among variables, rather than as generalizable findings derived from comprehensive primary field data. The analysis produced three main findings. First, the effectiveness of Posyandu is determined not only by the availability of services, but also by the quality of the service ecosystem, including facilities, midwife involvement, cadre capacity, and families' service experiences. Second, cadres serve as key drivers of service quality because they support not only the technical accuracy of nutritional assessments but also the development of community trust in Posyandu. Third, iron supplementation programs face an implementation paradox because tablet availability does not automatically result in adherence without support from schools, families, peers, behavioral education, and consistent reminder mechanisms. This article emphasizes that the success of community nutrition services is shaped more strongly by the quality of service interactions at the micro level than by program availability alone. It concludes that service ecosystems, implementer capacity, and social support should be understood as an interconnected system. Further empirical research is needed to examine these relationships using broader and more systematically measured field data.

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Introduction

Community nutrition problems in Indonesia are not only related to the availability of programs, but also to the quality of the service ecosystem that determines whether such programs are actually used and followed by the community. Posyandu, cadres, midwives, schools, families, and beneficiaries form an interdependent community nutrition service ecosystem. In this context, the research gap addressed in this article lies in the limited discussion that integrates three issues, namely the quality of Posyandu services, cadre capacity, and adherence to iron supplement consumption. Many studies have examined Posyandu, cadre training, or iron supplement adherence separately, but relatively few have interpreted all three as an interconnected community nutrition service system.

The urgency of this issue is reflected in the national nutrition situation, which still requires stronger basic services. The 2024 Indonesian Nutritional Status Survey reported that the national prevalence of stunting had declined to 19.8%, but this figure still indicates that stunting remains a serious public health problem. Meanwhile, the 2023 Indonesian Health Survey showed that the iron supplementation program for adolescent girls continues to face challenges related to coverage and access. The World Health Organization (2023) also emphasized that anemia among women of reproductive age and adolescent girls remains a global problem, with progress in its reduction occurring slowly. These facts show that the success of nutrition interventions cannot be assessed only by the existence of policies or programs, but also by the capacity of primary and community-based services to reach, influence, and sustain health behaviors within the population (Kementerian Kesehatan Republik Indonesia, 2024, 2025; World Health Organization [WHO], 2023).

In the context of children under five, Posyandu remains at the forefront of community-based health and nutrition services. However, the effectiveness of Posyandu cannot be separated from families' experiences of the services provided. Hapipah et al. (2024) showed that health facilities and the role of midwives were associated with mothers' attendance at Posyandu. This finding indicates that families are more likely to use Posyandu when services are perceived as prepared, welcoming, accessible, and beneficial. Within a broader framework, Grant et al. (2017) emphasized that community trust in community health workers is shaped by professionalism, relationship quality, and system support. Therefore, Posyandu quality is not determined only by the availability of a service location, but also by facilities, interaction quality, implementer capacity, and community trust.

Posyandu cadres occupy an important position within this ecosystem. Cadres do not only serve as technical personnel who assist with weighing and recording, but also act as social connectors between families and the health service system. Cadre training has been shown to improve knowledge and skills in anthropometric measurement, thereby contributing to better child growth monitoring (Suryani & Norhasanah, 2024). However, the role of cadres should be understood more broadly than technical competence alone. Skilled and communicative cadres who are trusted by the community can strengthen the credibility of Posyandu as a community service. Therefore, cadre capacity should be positioned as a key factor linking technical service quality with social acceptance by the community.

Among adolescent girls, community nutrition challenges are evident in the iron supplementation program. Alfiah et al. (2020) showed that coverage and adherence to weekly iron and folic acid supplementation among schoolgirls in Indonesia remained low. Hidayanty et al. (2025) also found that barriers to iron and folic acid consumption among adolescent girls were related not only to tablet availability, but also to unpleasant taste and smell, uncomfortable experiences, parental prohibition or support, concerns about bodily effects, forgetfulness, and support from schools, parents, and peers. Therefore, adherence to iron supplementation is a behavioral, social, and implementation issue rather than merely a logistical distribution problem.

Based on this mapping, the article positions community nutrition services as an ecosystem consisting of three main components. The first is the quality of the Posyandu ecosystem, including facilities, midwife support, active cadres, and families' service experiences. The second is cadre capacity, which affects both technical quality and community trust in the service. The third is adherence to iron supplementation, which is influenced by knowledge, perceptions of side effects, social norms, school support, family support, and reminder mechanisms. These three components need to be interpreted in an integrated manner because nutrition program failure often occurs not at the policy level, but at the micro level of interaction between service implementers and beneficiaries.

This article is not positioned as a fully empirical mixed-methods study. It was developed as a document-based conceptual analysis using thematic interpretation and descriptive elaboration. Several numerical values presented in the results were used as analytical simulations to clarify patterns of relationships among variables, rather than as generalizable findings from comprehensive primary field data. This clarification is important so that readers understand the status of the data and do not interpret the findings as definitive empirical evidence. Therefore, the purpose of this article is to develop an analytical framework that explains why community nutrition services may be effective or suboptimal based on service ecosystem quality, implementer capacity, and social support for health behavior.

Based on this background, the article addresses three main questions. First, how does the quality of the Posyandu service ecosystem influence family participation in health and nutrition services? Second, how does cadre capacity improve technical service quality while also building community trust in Posyandu? Third, why does the iron supplementation program for adolescent girls continue to face low adherence even though the intervention is systematically available? These questions are important because they help shift the discussion of nutrition services from program availability alone toward an understanding of implementation quality, social relationships, and beneficiary behavior.

As an analytical foundation, this article develops three conceptual propositions. First, Posyandu effectiveness is largely determined by the quality of the service ecosystem, particularly the availability of facilities, consistency of health worker support, cadre capacity, and families' service experiences. Second, cadre capacity not only improves the technical accuracy of nutrition services, but also strengthens the social legitimacy of Posyandu as a community service trusted by the public. Third, low adherence to iron supplementation among adolescent girls is not solely caused by inadequate program distribution, but is also influenced by perceptions of side effects, social norms, school support, family support, peer influence, and inconsistent reminder mechanisms. Through this framework, the article is expected to contribute conceptually to the development of community nutrition services that are more integrative, participatory, and responsive to beneficiary behavior.

Method

This article was developed as a document-based conceptual analysis involving thematic interpretation and descriptive quantitative elaboration. This approach was selected because the manuscript was not entirely based on newly collected primary field data obtained through surveys, interviews, or observations. Instead, it drew upon core documents, official reports, previous studies, and analytical development related to community nutrition services. Therefore, this article is not positioned as a fully empirical mixed-methods study, but as a conceptual and analytical review that uses documentary data and simulated figures to explain patterns of relationships among the quality of the Posyandu ecosystem, cadre capacity, and adherence to iron supplementation.

Clarifying this methodological position is important so that readers can accurately understand the status of the data. Numerical values presented in the results, such as Posyandu

attendance coverage, increases in cadre scores, anthropometric measurement accuracy, and iron supplement adherence rates, were positioned as analytical simulations used to illustrate the direction of relationships among variables. These figures were not intended as empirical generalizations derived from comprehensive primary field data. Therefore, their function in this article is to provide descriptive illustrations that strengthen the structure of the argument rather than serve as a basis for statistical inference, hypothesis testing, or causal proof.

Conceptually, the article examines community nutrition services through three main components. The first is the quality of the Posyandu service ecosystem, including facilities, midwife involvement, service interaction quality, and families' experiences in using services. The second is the capacity of Posyandu cadres as community-based service providers who contribute to anthropometric measurement, nutrition education, record keeping, and the development of community trust. The third is adherence to iron supplementation among adolescent girls, which is interpreted as an issue involving behavior, social support, education, distribution, and supervision. This framework was developed to show that the effectiveness of community nutrition services cannot be understood only through program availability, but must also be examined through service ecosystem quality and the social interactions that support it.

The data sources in this article consisted of three groups. The first included core documents that formed the basis of the manuscript and contained information on Posyandu, cadres, service facilities, midwife support, cadre empowerment, and iron supplement adherence. The second included official reports and policy documents, such as the Indonesian Health Survey, the Indonesian Nutritional Status Survey, and WHO reports on anemia. The third consisted of previous scientific articles relevant to community nutrition services, Posyandu cadres, iron and folic acid supplementation, and adherence behavior among adolescent girls. The use of documents as the main data source is appropriate in conceptual studies because it enables researchers to systematically examine content, patterns, and relationships among ideas (Dalglish et al., 2020; Jaakkola, 2020).

The units of analysis were not individual respondents, but conceptual categories derived from the actors and service components discussed in the documents. These units included mothers of children under five as Posyandu service users, Posyandu cadres as community-based service providers, midwives as professional support personnel, families as supporters of health behavior, schools as settings for iron supplement distribution, and adolescent girls as program beneficiaries. The units of analysis were selected purposively based on their relevance to the focus of the article. Such purposive strategies are commonly used in qualitative and conceptual analyses when researchers select the most information-rich elements to explain a particular phenomenon (Campbell et al., 2020).

The analysis was conducted in five stages. The first stage involved identifying documents and mapping the main issues. At this stage, the authors examined sections related to Posyandu quality, cadre roles, midwife support, maternal attendance, cadre training, anthropometric measurement, and iron supplement adherence among adolescent girls. The second stage involved information extraction, in which relevant information was taken from the documents and literature and organized into initial categories. The third stage was thematic coding, which grouped information into major themes such as "Posyandu service ecosystem," "cadre capacity," "community trust," "iron supplement adherence," "school support," "family support," and "adolescent behavioral barriers." The fourth stage involved descriptive quantitative elaboration, in which simulated figures were developed to clarify analytical patterns. The fifth stage involved conceptual integration, linking the themes into an argumentative framework explaining the relationships among service quality, implementer capacity, and beneficiary behavior.

Thematic analysis was used to identify recurring patterns of meaning in the documents and literature. The procedure involved repeated reading, marking important ideas, generating initial codes, grouping the codes into themes, and interpreting the themes according to the research

focus. Thematic analysis was selected because it is suitable for organizing narrative data and developing a conceptual understanding of complex social and health phenomena (Braun & Clarke, 2023; Kiger & Varpio, 2020). In this article, thematic analysis was not intended to produce a fully developed new theory, but to construct a more structured framework for interpreting community nutrition services.

Descriptive quantitative elaboration was used in a limited manner to clarify the direction of the findings. The figures included in this article were not treated as primary survey results, but as analytical simulations. For example, comparisons of Posyandu attendance coverage between complete service ecosystems and settings with limited facilities were used to illustrate how service quality may influence family participation. Similarly, simulated increases in cadre scores were used to demonstrate how training may relate to improved technical capacity. In the iron supplementation program, simulated adherence rates were used to show that tablet distribution is not always equivalent to actual consumption. Therefore, the figures functioned as explanatory aids rather than final empirical evidence.

To maintain methodological transparency, the article distinguished among three types of data. The first was documentary data, consisting of information from core documents, official reports, and scientific articles. The second was literature findings, comprising results from previous studies used to support or compare arguments. The third was analytical simulation, consisting of descriptive figures developed to illustrate patterns of relationships among variables. This distinction was important because reviewers had emphasized the need to clearly differentiate empirical data from simulated data. Through this explanation, readers can understand that simulated figures were not used for generalization, but to clarify the conceptual model being developed.

Table 1. Data Status and Analytical Function in the Article

Type of Data	Source	Function in the Article	Methodological Status
Documentary data	Core documents, official reports, and scientific articles	Provides the basis for mapping issues related to Posyandu, cadres, and iron supplementation	Secondary or documentary data
Literature findings	Previous studies on Posyandu, cadres, anemia, and iron supplement adherence	Supports, compares, and strengthens the discussion	Empirical evidence from previous studies
Analytical simulation	Authors' elaboration based on conceptual patterns	Clarifies tendencies in relationships among variables	Descriptive illustration, not primary field data
Conceptual synthesis	Integration of themes and literature	Develops the framework of the community nutrition service ecosystem	Conceptual analysis

The findings were presented narratively and analytically through three main focuses. The first focus examined the quality of the Posyandu ecosystem as a determinant of family participation. The second examined cadre capacity as a driver of technical quality and community trust. The third examined the paradox of iron supplement adherence, referring to the condition in which the intervention is available but actual consumption remains low. Each focus was analyzed by comparing conceptual patterns, descriptive simulations, and findings from previous studies. Through this approach, the article sought to produce a discussion that was not only

descriptive, but also analytical and reflective regarding the implementation challenges of community nutrition services.

The methodological limitations of the article also need to be emphasized. Because the manuscript was developed as a document-based conceptual analysis using analytical simulation, its findings cannot yet be generalized as national empirical evidence. The article did not conduct statistical testing, did not assess causal relationships, and did not use a representative primary field sample. Therefore, the conclusions should be interpreted as an initial framework for understanding challenges in community nutrition services rather than as final evidence. Further research is required using stronger empirical designs, such as field surveys, longitudinal studies, or fully empirical mixed-methods research that collects primary data from mothers of children under five, Posyandu cadres, midwives, teachers, families, and adolescent girls.

Through this design, the method is expected to be more transparent and consistent with the status of the data used. The article retains academic value because it develops a conceptual framework integrating Posyandu service quality, cadre capacity, and iron supplement adherence within a unified interpretation of the community nutrition service ecosystem. However, this contribution should be positioned as conceptual and analytical rather than as causal empirical proof.

Results

Status of the Resulting Data

The results presented in this article should be understood as outcomes of a document-based conceptual analysis clarified through analytical simulations, rather than as findings from a complete primary field survey. Figures such as Posyandu attendance coverage of 81.4% and 49.7%, increases in cadre scores from 58.3 to 84.6, improvements in measurement accuracy from 63.0% to 88.7%, and an iron supplement adherence rate of 38.8% were used to illustrate descriptive tendencies in the relationships among variables. Therefore, these figures were not used for population generalization, statistical testing, or causal verification. Instead, they served as analytical illustrations to clarify patterns connecting the quality of the Posyandu ecosystem, cadre capacity, and adherence to iron supplementation.

The Quality of the Posyandu Ecosystem as a Determinant of Service Utilization

The analysis shows that Posyandu continues to hold a strategic position in community health and nutrition services. However, the effectiveness of Posyandu cannot be adequately explained by its existence as a community service alone. The analytical simulation indicated that Posyandu with more comprehensive service support, including active cadres, adequate anthropometric equipment, and consistent midwife involvement, achieved monthly child attendance coverage of 81.4%. In contrast, Posyandu with limited facilities and less stable technical support achieved only 49.7% coverage.

This difference suggests that family participation is influenced not only by community awareness, but also by the quality of the service ecosystem experienced by families. Families are more likely to use Posyandu when services are perceived as prepared, welcoming, accessible, and beneficial. Therefore, Posyandu success depends not only on service schedules, but also on facility readiness, the presence of supporting health personnel, the quality of cadre communication, and family trust in the services provided.

Cadre Capacity as a Driver of Community Nutrition Service Quality

The second finding indicates that cadre capacity is an important factor in improving the quality of community-based nutrition services. An analytical simulation involving 30 cadres showed an increase in the mean knowledge score from 58.3 to 84.6 after an educational intervention. In addition, the accuracy of weight and height measurements increased from 63.0% to 88.7%.

This finding suggests that cadre training not only improves knowledge, but may also strengthen the quality of technical practices in nutrition services. Improved measurement accuracy is important because errors in measuring body weight, height, or body length can affect the accuracy of early detection of stunting, wasting, and other nutritional problems. Therefore, cadres should not be understood merely as administrative personnel, but as community actors who influence data quality, growth-monitoring accuracy, and family trust in Posyandu services.

The simulation also indicates that cadre capacity is associated with service credibility. Posyandu supported by communicative and skilled cadres who are able to explain nutrition-monitoring results in simple language may be more successful in building community trust. Therefore, cadre capacity has two main functions: a technical function in nutrition measurement and recording, and a social function in building relationships with families.

The Paradox of the Iron Supplementation Program: Availability without Optimal Adherence

The third finding reveals a paradox in the iron supplementation program for adolescent girls. Although the program is systematically available, adherence remains suboptimal. Based on an analytical simulation involving 80 adolescent girls, only 38.8% consumed iron supplements regularly, while 61.2% consumed them irregularly because of factors such as forgetfulness, discomfort caused by side effects, limited understanding of long-term benefits, or insufficient social support.

This finding shows that the availability of iron supplements does not automatically lead to consistent consumption behavior. Adherence among adolescent girls is more complex because it is influenced by perceptions of side effects, tablet-taking habits, peer norms, family support, teacher involvement, and reminder mechanisms within schools. The simulation also suggested that schools implementing teacher supervision and weekly reminders had adherence rates 2.1 times higher than schools that only distributed the tablets without additional support. Therefore, the success of iron supplementation programs should not be assessed solely from tablet distribution, but also from actual consumption and the social support accompanying it.

Synthesis of the Findings

Overall, the analysis shows that community nutrition services cannot be understood solely through the existence of programs. Posyandu, cadres, and iron supplementation are components of an interconnected service ecosystem. Posyandu becomes more effective when facilities, cadres, and midwives work in an integrated manner. Cadres become service drivers when they possess strong technical and communication skills. Meanwhile, iron supplementation programs become more successful when tablet distribution is accompanied by education, social support, reminders, and consumption monitoring.

The central finding of this article is that the quality of service interactions at the micro level has a stronger role in determining the success of community nutrition services than the mere existence of policies or programs. However, because these findings were developed through document analysis and analytical simulations, they should be positioned as an initial framework for further empirical research.

Discussion

The Posyandu Ecosystem: Facilities, Cadres, and Midwives as Mutually Reinforcing Components

The first finding indicates that Posyandu is effective when it is supported by an adequate service ecosystem. In this context, facilities, cadres, and midwives do not operate as separate factors, but as mutually reinforcing components. Adequate facilities allow measurements to be conducted more accurately. Skilled cadres support service delivery, communication, and record keeping.

Midwives or other professional health workers strengthen the technical legitimacy of services, particularly when families require explanations or follow-up care.

Therefore, the most influential factor is not one individual component, but the consistency with which these three elements work together to create a service experience trusted by families. This finding is consistent with Hapipah et al. (2024), who showed that health facilities and the role of midwives were associated with mothers' attendance at Posyandu. However, this article adds that the relationship should be interpreted as an ecosystem process rather than as a simple linear relationship. Posyandu becomes stronger when families perceive that the service has adequate equipment, competent personnel, and respectful communication.

In community-based health services, public trust in service providers is an important factor. Although Grant et al. (2017) was published more than five years ago, its findings remain relevant because they show that acceptance of community-based services is influenced by trust in health workers. These findings can be integrated with more recent studies emphasizing the importance of micro-level interaction quality, system support, and continuity of assistance. In this article, the Posyandu ecosystem is understood as a meeting point among policy, field-level implementers, and family experiences.

Cadre Capacity: From Technical Competence to Social Credibility

The second finding confirms that cadres are key drivers of nutrition service quality. Trained cadres can improve the accuracy of anthropometric measurements and the quality of basic services. This finding is consistent with Suryani and Norhasanah (2024), who showed that training improved the knowledge and skills of Posyandu cadres in anthropometric measurement. Fitriani and Purwaningtyas (2020) also reported that anthropometric training increased cadre knowledge and skills.

However, the discussion of cadre capacity should not stop at technical competence. In community services, cadres also perform important social functions. They are often the first representatives of the service encountered by families, explain measurement results, remind families about Posyandu schedules, and help build the perception that Posyandu provides useful services. Therefore, cadre capacity produces two related effects: improved data quality and increased community trust.

Suarayasa et al. (2024) emphasized that cadre empowerment contributes to stronger early detection of stunting and should be implemented systematically. This article extends that argument by emphasizing that competent cadres not only produce more accurate measurements, but also strengthen the social legitimacy of Posyandu. Cadres are not merely program implementers, but key actors connecting families with primary health services.

The Iron Supplementation Paradox and Adherence Behavior among Adolescent Girls

The third finding demonstrates that iron supplementation programs face a common implementation problem in public health, namely a gap between intervention availability and actual adherence. Tablets may be available and distributed, but they are not always consumed regularly. Alfiah et al. (2020) showed that coverage and adherence to weekly iron and folic acid supplementation among Indonesian schoolgirls remained low. This finding supports the article's analysis that logistical distribution alone is insufficient to guarantee behavioral change.

Adherence to iron supplementation among adolescent girls is influenced by various behavioral and social factors. Hidayanty et al. (2025) found that barriers to regular consumption among Indonesian adolescent girls included unpleasant taste and smell, negative experiences after consumption, concerns about menstrual changes, parental restrictions, and forgetfulness. In contrast, enabling factors included awareness of benefits, trust in supplements distributed through schools, parental support, and peer support. These findings clarify that adherence cannot be improved through health education alone, but requires consistent social support.

Social norms are also important. Adolescent girls may avoid consuming iron supplements because they fear being perceived as ill, do not want to appear different from their peers, or feel uncomfortable discussing side effects. Side effects such as nausea, unpleasant taste, or perceived bodily changes may also reduce motivation. Therefore, iron supplementation programs should be understood as behavioral interventions rather than as supplement distribution programs alone. Schools, teachers, families, and peers should all be incorporated into the adherence-support system.

School, Family, and Peer Support as Reinforcers of Adherence

Adherence to iron supplementation is more likely to improve when supervision and reminders are provided consistently. Nuradhiani et al. (2018) found that teacher support increased adherence to iron supplement consumption among adolescent girls in Bogor City. Although the study was published more than five years ago, its findings remain relevant to the Indonesian context because they identify teachers as important actors in adolescent adherence.

A more recent study by Jayanti and Anggraeni (2025) showed that family, teacher, and peer support were associated with adherence to iron and folic acid supplementation among adolescent girls. This supports the argument that successful iron supplementation programs depend on organized social support. When teachers only distribute tablets without reminders, adherence tends to remain low. In contrast, when schools establish weekly routines, provide clear explanations, and involve peers in reinforcing positive norms, adherence is more likely to improve.

Therefore, discussion of iron supplementation needs to shift from asking whether tablets are available to asking whether adolescent girls actually consume them regularly and receive sufficient support from their social environment. This shift is important because administrative indicators, such as the number of tablets distributed, do not necessarily reflect actual changes in health behavior.

Integration of the Three Components of Community Nutrition Services

This article places Posyandu, cadre capacity, and iron supplementation within one community nutrition service framework. Although these components appear different, they share a similar implementation logic. Posyandu requires facilities, cadres, and midwives to encourage family participation. Cadres require training and support to provide accurate and trusted services. Iron supplementation requires education, reminders, and social support to improve adherence among adolescent girls.

This framework is consistent with WHO (2023), which emphasized that accelerating anemia reduction requires comprehensive, multisectoral approaches and the empowerment of individuals, families, communities, and health systems. Nutrition programs should therefore not be designed only at the policy level, but must also be supported by mechanisms that can be implemented effectively at the micro level. This represents the conceptual contribution of the article: the success of community nutrition services is determined by ecosystem quality, not merely by program availability.

Limitations

First, the findings were derived from document analysis and analytical simulations rather than from complete primary field data. Therefore, the figures presented cannot be generalized as national empirical findings. Second, the article did not conduct statistical testing or assess causal relationships among variables. Third, respondent characteristics, research instruments, and primary data collection procedures were not fully available. Fourth, some empirical references were drawn from different local contexts and should therefore be interpreted as comparative evidence rather than direct evidence representing all regions of Indonesia.

Nevertheless, these limitations do not eliminate the contribution of the article. Instead, the article provides an initial conceptual framework for developing future empirical studies. Further research should examine relationships among Posyandu ecosystem quality, cadre capacity, and iron supplement adherence using stronger field data, longitudinal designs, or fully empirical mixed-methods studies that collect primary data from mothers of children under five, cadres, midwives, teachers, families, and adolescent girls.

Conclusion

This article concludes that the effectiveness of community-based health and nutrition services is determined not only by the presence of programs, but also by the quality of the service ecosystem supporting them. Posyandu becomes more meaningful when facilities are adequate, cadres are active, and health workers consistently assist the community. Cadres contribute not only to measurement and record keeping, but also to building family trust in the service. Meanwhile, iron supplementation programs for adolescent girls face a paradox because tablet availability does not automatically result in strong adherence.

The primary contribution of this article is its integrative interpretation of three components of community nutrition services: Posyandu ecosystem quality, cadre capacity, and iron supplement adherence. The article emphasizes that the failure or success of nutrition programs often occurs at the micro level, particularly through the quality of interactions between service implementers and beneficiaries. Therefore, community nutrition services need to shift from a distribution-oriented approach toward an ecosystem-based approach that emphasizes facilities, implementer competence, trust, behavioral education, and social support.

However, these conclusions should be interpreted cautiously because the article was developed as a document-based conceptual analysis supported by analytical simulations. The figures used in the results serve as descriptive illustrations and are not primary field data that can be generalized. Therefore, the article is more appropriately positioned as a conceptual foundation for further empirical research.

Future research should use primary field data with clearly defined samples, standardized instruments, and designs capable of testing relationships among variables more rigorously. Further studies may employ empirical mixed-methods or longitudinal designs to examine how Posyandu facilities, cadre competence, midwife involvement, family support, school support, peer norms, and perceptions of side effects influence service participation and adherence to iron supplementation. With stronger empirical testing, the conceptual framework proposed in this article may be developed into more applicable policy recommendations and intervention models for strengthening community nutrition services in Indonesia.

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Research Ethics Statement

This study was conducted in accordance with the ethical principles of scientific research, including academic honesty, scientific responsibility, transparency, and the responsible use of published sources. Since this article employed a document-based conceptual analysis and did not

directly involve human participants, primary data collection, clinical interventions, or the collection of personally identifiable information, informed consent and formal ethical approval were not required. Nevertheless, the authors maintained academic integrity, accurately represented the reviewed evidence, properly acknowledged all cited sources, and clearly distinguished documentary evidence from analytical simulations throughout the research and reporting process.

Author Contributions

Dewi Claudia Angelina Putri: conceptualization, literature and document collection, formal analysis, conceptual synthesis, and writing of the original draft.

Hafiz Ridha Andreas: literature and document collection, data organization, literature review, and preparation of supporting materials.

Iqlima Kalimatus Shalihka: methodology, validation of the analytical framework, thematic analysis, and interpretation of findings.

Marsela: literature and document collection, organization of the results, and initial manuscript editing.

Resti: substantive review, conceptual interpretation, and refinement of the manuscript content.

Rifqi Ramadan: academic supervision, manuscript finalization, critical review, and final editing.

All authors have read, reviewed, and approved the final version of the manuscript.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the research, authorship, or publication of this article.

Artificial Intelligence Use Statement

The authors declare that artificial intelligence, if used, was employed only as a limited technical support tool for language editing, sentence refinement, grammar checking, translation assistance, and improving manuscript readability. All processes involving literature selection, conceptual analysis, thematic interpretation, analytical simulation, academic argumentation, and conclusion development remain the full responsibility of the authors.

Data Availability Statement

The materials supporting the findings of this study consist of published scientific articles, official reports, policy documents, analytical notes, thematic coding records, and conceptual synthesis materials related to the Posyandu service ecosystem, cadre capacity, and adherence to iron supplementation among adolescent girls. The numerical values presented as analytical simulations do not constitute a primary field dataset. Additional information regarding the reviewed materials and analytical procedures may be obtained from the corresponding author upon reasonable request.

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