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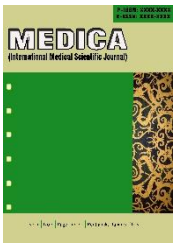

Integrated Behavioral Practices among Mothers of Stunted Children in a River Basin Community

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Abstract

Stunting remains a significant public health challenge, particularly in vulnerable communities such as urban riverine settlements. This study aimed to evaluate changes in key behavioral practices following the implementation of an integrated behavioral intervention among mothers of stunted children under five in the Kapuas River Basin community of Pontianak. This study employed a one-group pretest–posttest quasi-experimental design involving 30 mothers of stunted children. The intervention consisted of modules on household hygiene practices, responsive caregiving, and active feeding practices, delivered through direct facilitation by trained health workers at Posyandu (integrated health service posts). Data were analyzed using paired sample t-tests to assess differences before and after the intervention. The findings demonstrated significant improvements across all three behavioral domains. Household hygiene practices improved with a moderate effect size, indicating better hygiene behaviors at the household level. The greatest improvement was observed in responsive caregiving, with a large effect size reflecting enhanced caregiver child interactions following the intervention. Active feeding practices also showed improvement, although with a small-to-moderate effect size, suggesting that changes in feeding behavior may require more intensive and sustained support. In conclusion, community-based integrated behavioral interventions are effective in improving caregiving and hygiene practices associated with stunting risk pathways in urban riverine communities. These findings highlight the importance of context-specific behavioral strategies as part of comprehensive, community-based stunting prevention efforts in high-risk environments.

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1. INTRODUCTION

Stunting continues to represent a major global public health challenge. In 2024, approximately 150.2 million children under five were affected worldwide, reflecting a decline from 177.9 million in 2012; however, the current pace of reduction remains insufficient to achieve the global target of a 40% reduction by 2030 (UNICEF & WHO, 2025; UNICEF, WHO, & World Bank, 2025). Globally, Asia and Africa account for the vast majority of stunting cases (Azriani et al., 2024; UNICEF, WHO, & World Bank, 2025). Within Asia, Southeast Asia alone accounted for approximately 11.6 million cases in 2024, representing about 15.1% of the regional burden (UNICEF, WHO, & World Bank, 2025), and previous reviews have suggested that the region may contribute more than one-quarter of the global burden of stunting (Azriani et al., 2024). These patterns indicate that stunting remains disproportionately concentrated in developing countries, where structural, environmental, and behavioral determinants interact to shape child nutritional outcomes.

Beyond its high prevalence, stunting has profound and long-term consequences for child development. Children affected by stunting may fail to reach their full physical height and cognitive potential (UNICEF, WHO, & World Bank, 2025). Undernutrition during the critical first 1000 days of life can disrupt cognitive and motor development, increase susceptibility to infectious diseases, and contribute to persistent developmental deficits (Mulyani et al., 2025; Soliman et al., 2021). Evidence suggests that stunted children experience approximately 7% lower cognitive development outcomes compared with their non-stunted peers (Ekholuenetale et al., 2020). In Indonesia, stunting is also associated with impaired intellectual functioning that affects children's physical and mental development as well as their future learning capacity (Rambe et al., 2023; Sekretariat Wakil Presiden Republik Indonesia, 2019). These consequences underline the urgency of addressing not only the prevalence but also the underlying determinants of stunting.

In Indonesia, the national prevalence of stunting has declined to 19.8%. Nevertheless, substantial disparities persist across regions, including in West Kalimantan Province (26.8%) and Pontianak City (22.3%) (Ministry of Health of the Republic of Indonesia, 2025a; Ministry of Health of the Republic of Indonesia, 2025b). Such subnational variation reflects differences in social environments, living conditions, and access to health services that influence child nutrition. Previous studies consistently demonstrate that environmental and behavioral factors such as drinking water quality, sanitation, hygiene practices, caregiving behaviors, and child feeding practices are strongly associated with stunting across diverse settings (Arief et al., 2025; Beal et al., 2018; Silva et al., 2023; Torlesse et al., 2016). However, most of these studies are observational in nature and primarily focus on identifying risk factors rather than evaluating behavior change outcomes.

Environmental context also plays an important role in shaping vulnerability to child undernutrition. Urban riverine communities, for instance, face distinct ecological and social challenges compared with rural areas or urban settlements located away from rivers. Several local studies conducted in Pontianak have reported associations between household sanitation conditions, water quality, family functioning, and caregiving practices with stunting among children under five (Desi & Trihardiani, 2021; Oktaviana et al., 2024; Rizky & Marlenywati, 2022). Settlements along riverbanks are often characterized by high population density, limited access to adequate sanitation infrastructure, persistent environmental exposure, and ongoing socioeconomic pressures. These conditions may increase the risk of recurrent infections and poor hygiene practices, which in turn contribute to pathways leading to stunting through suboptimal caregiving and feeding

practices (Hasyim et al., 2025; Khaerani et al., 2025). Despite this growing body of evidence, there remains limited research that specifically evaluates integrated behavioral interventions tailored to the unique ecological characteristics of urban riverine communities.

A growing body of evidence highlights the role of WASH (water, sanitation, and hygiene) factors including household hygiene behaviors such as handwashing with soap as well as caregiving practices as key determinants of child growth and development (Azriani et al., 2024; Silva et al., 2023; Rahut et al., 2024; Zahtamal et al., 2024). However, much of the existing literature remains dominated by cross-sectional and regression-based analyses, with limited quasi-experimental or intervention-based studies assessing behavioral change, particularly in specific high-risk contexts such as river basin communities (Arief et al., 2025; Siramaneerat et al., 2024; Torlesse et al., 2016). In Indonesia, research related to stunting often emphasizes program monitoring rather than evaluating the effectiveness of integrated behavioral strategies at the household level (Rusdianti et al., 2025). Therefore, a clear research gap exists in examining how integrated interventions that combine hygiene promotion, responsive caregiving, and feeding practices can influence maternal behavior in ecologically vulnerable settings.

The present study offers novelty by implementing and evaluating an Integrated Behavioral Intervention Model that simultaneously targets multiple behavioral domains household hygiene, responsive caregiving, and active feeding practices within the specific context of an urban riverine community in the Kapuas River Basin, Pontianak. Unlike previous studies that focus on single determinants or rely on observational data, this study applies a quasi-experimental approach to assess behavioral changes before and after the intervention. Grounded in behavioral change theory and the socio-ecological framework, this study positions caregiver behavior as a modifiable proximal determinant of stunting risk. Therefore, the objective of this study is to evaluate the effect of the integrated behavioral intervention on changes in maternal caregiving behaviors, specifically household hygiene practices, responsive caregiving, and active feeding practices, among mothers of stunted children under five in a river basin community.

2. METHOD

This study employed a one-group pretest–posttest quasi-experimental design (O_1–X–O_2) to assess changes in caregiver behaviors following the implementation of an integrated nutrition–behavioral intervention among families with stunted children under five in the Kapuas River Basin area, Tambelan Sampit Village, Pontianak City. The study was conducted over a five-month period. The unit of analysis was the mother as the primary caregiver, while the child's stunting status served as the inclusion criterion. A total of 30 mothers with stunted children under five were recruited using purposive sampling. This sampling approach was selected to ensure the feasibility of delivering intensive interventions, conducting repeated measurements, and maintaining relative homogeneity within the target population in a single riverine community. Participants were drawn from five Posyandu (integrated health service posts), namely Kasih Ibu, Srikandi, Wanita Karya, Rosylin, and Rosa, representing community-based health service units in the study area.

The intervention consisted of an integrated behavioral approach designed to improve caregiver practices. It included education on proper handwashing with soap, strengthening household hygiene practices, and promoting responsive caregiving through the "Orang Tua Hebat" (Great Parents) module. Additionally, facilitation was provided to encourage the utilization of Posyandu services and participation in the DASHAT program (a community-based nutrition initiative), including the use of nutritious menu report cards

to support appropriate child feeding practices and nutritional monitoring. Each component of the intervention was delivered through three structured facilitation sessions conducted by trained health workers. The intervention schedule was deliberately condensed to minimize potential threats to internal validity, particularly history and maturation effects.

Data collection was conducted before and after the intervention using a structured questionnaire that measured three main behavioral domains: household hygiene practices, responsive caregiving, and active feeding practices. The instrument was developed based on hygiene behavior indicators issued by the Ministry of Health, as well as established frameworks on responsive caregiving and child feeding practices reported in previous studies. Content validity was evaluated through expert judgment, while reliability was ensured through the consistent use of the same instrument and standardized data collection procedures during both pretest and posttest assessments.

Data analysis was performed using both univariate and bivariate statistical methods. Univariate analysis was used to describe the characteristics of respondents, while bivariate analysis was conducted to examine differences between pre- and post-intervention scores. A paired sample t-test was applied to assess changes in the three dependent variables. The assumption of normality for the distribution of difference scores was met, justifying the use of parametric testing. Statistical significance was set at $p < 0.05$. In addition, effect size was calculated using Cohen's d to determine the magnitude of behavioral changes observed following the intervention.

This study received ethical approval from the Health Research Ethics Committee of the Faculty of Health Sciences, Universitas Muhammadiyah Pontianak, with reference number 016/KEPK-FikPsi/UM PONTIANAK/2025. The study adhered to ethical research principles. Written informed consent was obtained from all participants prior to data collection. Participant confidentiality and anonymity were strictly maintained, and all data collected were used solely for research purposes.

3. RESULTS AND DISCUSSION

Table 1. Sample Characteristics (n = 30).

Characteristics	Category	Frequency (n)	Percentage (%)
Participating Posyandu	Rosylin	11	36.7
	Kasih Ibu	6	20.0
	Srikandi	5	16.7
	Wanita Karya	5	16.7
	Rosa	3	10.0
Child Sex	Male	11	36.7
	Female	19	63.3
Birth Length	Short (< 47 cm)	19	63.3
	Normal (≥ 47 cm)	11	36.7
Birth Weight	Low birth weight (< 2500 g)	3	10.0
	Normal (≥ 2500 g)	27	90.0
Maternal Education	Elementary school	10	33.3
	Junior high school	9	30.0
	Senior high school	10	33.3
	Higher education	1	3.3
Maternal Employment Status	Employed	6	20.0
	Not employed	24	80.0

Characteristics	Category	Frequency (n)	Percentage (%)
Child Nutritional Status (HAZ)	Stunted + Severely stunted	20	66.7
	Normal	10	33.3

Table 1 presents the characteristics of the study participants, consisting of 30 mothers with children under five. The majority of participants were recruited from the Rosylin Posyandu (36.7%), followed by Kasih Ibu (20.0%), while the remaining participants were distributed across Srikandi, Wanita Karya, and Rosa Posyandu. Based on child characteristics, most children were female (63.3%). A large proportion of children had a short birth length (<47 cm) (63.3%), indicating a potential early-life growth constraint. However, most children were born with normal birth weight (90.0%), suggesting that stunting in this population may not be primarily associated with low birth weight but rather postnatal factors such as nutrition and caregiving practices.

In terms of maternal characteristics, the majority of mothers had low to no educational attainment, with most having completed elementary (33.3%) or senior high school (33.3%), and only a small proportion having higher education (3.3%). Additionally, most mothers were not employed (80.0%), which may influence caregiving patterns and time allocation for child care. Regarding nutritional status, two-thirds of the children (66.7%) were classified as stunted or severely stunted, confirming that the study sample represents a high-risk group. Overall, these findings indicate that the study population is characterized by socioeconomic and early-life risk factors that may contribute to suboptimal child growth, particularly within the context of riverine communities.

Table 2. Paired Sample t-Test Results Comparing Pre- and Post-Intervention Scores (n = 30).

Variables	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	p-value	Cohen's d
Household hygiene practices	74.77 ± 17.09	84.23 ± 11.29	0.003	0.59
Responsive caregiving	31.60 ± 8.07	36.70 ± 5.69	< 0.001	1.00
Active feeding practices	2.80 ± 1.16	3.27 ± 0.91	0.046	0.38

Note: *Cohen's d was calculated based on paired differences. A p-value < 0.05 was considered statistically significant. Effect sizes were interpreted as small (0.20–0.49), moderate (0.50–0.79), and large (≥ 0.80).*

Table 2 shows significant improvements in all caregiver behavioral domains following the integrated behavioral intervention. Household hygiene practices increased from a mean score of 74.77 ± 17.09 before the intervention to 84.23 ± 11.29 after the intervention ($p = 0.003$), with a moderate effect size (Cohen's $d = 0.59$), indicating a meaningful improvement in household hygiene behaviors.

Responsive caregiving demonstrated the greatest improvement, with mean scores increasing from 31.60 ± 8.07 to 36.70 ± 5.69 ($p < 0.001$). The effect size was large (Cohen's $d = 1.00$), suggesting that the intervention had a substantial impact on enhancing caregiver child interactions and responsive parenting practices.

Active feeding practices also improved significantly, with mean scores increasing from 2.80 ± 1.16 to 3.27 ± 0.91 ($p = 0.046$). However, the magnitude of change was relatively smaller, as indicated by a small effect size (Cohen's $d = 0.38$). This finding suggests that while feeding behaviors improved after the intervention, changes in this

domain may require longer duration or more intensive support to achieve stronger behavioral modification. Overall, these findings indicate that the integrated behavioral intervention was effective in improving maternal caregiving behaviors, particularly in responsive caregiving and household hygiene practices, among mothers of stunted children in the Kapuas River Basin community.

The improvement in household hygiene practice scores observed in this study indicates meaningful changes in domestic hygiene behaviors among participating mothers. This finding aligns with previous literature identifying WASH-related behaviors as critical determinants of stunting risk through pathways involving recurrent infections and environmental enteropathy that interfere with nutrient absorption (Silva et al., 2023; Nasyidah et al., 2022; Torlesse et al., 2016). The moderate effect size suggests that the intervention was particularly effective in influencing behaviors that depend on individual practices, such as handwashing with soap and the safe handling of food and drinking water. However, behaviors requiring improvements in sanitation infrastructure such as access to improved toilets remain structural challenges in riverine settlements along the Kapuas River. These findings are consistent with previous local and regional studies reporting associations between household sanitation conditions and stunting risk (Desi & Trihardiani, 2021; Rizky & Marlenywati, 2022; Setyawan et al., 2025; Zahtamal et al., 2024).

Responsive caregiving demonstrated the greatest improvement among all behavioral variables, with a large effect size (Cohen's d = 1.00), indicating that the intervention successfully enhanced sensitive and reciprocal caregiver child interactions. The intervention modules emphasized recognizing children's cues and responding appropriately during caregiving and feeding interactions, which may directly address unmet caregiving needs among mothers living in riverbank communities facing socioeconomic pressures. In such contexts, structured parenting guidance may have previously been limited. Nevertheless, the magnitude of this effect should be interpreted cautiously due to the relatively small sample size and the short-term nature of the evaluation. Most mothers in the study were not formally employed and had varied educational backgrounds, suggesting that the intervention may have provided both practical knowledge and psychosocial reinforcement of caregiving roles. This, in turn, may have strengthened maternal self-efficacy and reduced parenting stress, contributing to improved caregiving quality and feeding interactions (Arief et al., 2025; Beal et al., 2018; Oktaviana et al., 2024; Pérez-Escamilla et al., 2021; Pertiwi & Hendrati, 2023; Saleh et al., 2021). Similar findings have been reported in Indonesian studies, highlighting the importance of maternal caregiving practices in reducing the risk of stunting among children in low-income communities.

Active feeding practices also improved following the intervention, although the magnitude of change was relatively modest. The increase in mean scores suggests early improvements in feeding behaviors, including greater responsiveness to child hunger cues and increased encouragement of child participation during feeding. However, the small effect size indicates that behavioral change in feeding practices may require longer intervention duration and repeated mentoring sessions. Feeding practices are inherently complex and are influenced by psychosocial factors, time constraints, and contextual pressures experienced by caregivers (Pérez-Escamilla et al., 2021). Consistent with this finding, previous evaluations of community-based nutrition programs have shown that sustained counseling and repeated engagement are necessary to achieve stable and meaningful improvements in feeding behaviors (Doustmohammadian et al., 2022; Jalaludin et al., 2025).

Taken together, the simultaneous improvements observed across household hygiene practices, responsive caregiving, and active feeding practices suggest that integrated behavioral interventions can effectively address multiple behavioral risk factors associated with stunting. Previous studies have emphasized the advantages of multisectoral interventions that combine WASH, caregiving, and nutrition components compared with single-component approaches (Jalaludin et al., 2025; Setyawan et al., 2025). In urban riverine settlements, environmental vulnerability and social constraints interact in complex ways to influence child nutrition outcomes. Therefore, intervention strategies must be tailored to the specific ecological and social characteristics of the target communities. Variability in intervention effectiveness across rural, urban, and peri-urban settings has been widely reported (Goudet et al., 2019; Siramaneerat et al., 2024), and these contextual factors should be considered when interpreting the present findings.

Several limitations of this study should be acknowledged. First, the study focused on behavioral outcomes reported by caregivers without directly measuring biological or anthropometric improvements among children; therefore, causal conclusions regarding linear growth improvement cannot be established. Second, the relatively small sample size and limited geographic scope restrict the generalizability of the findings. Third, the results may be subject to social desirability bias, as respondents may report improved behaviors following the intervention due to perceived expectations from researchers or community health cadres. Finally, although some children were classified as having normal nutritional status at follow-up, all participants had a history of growth disturbances and thus remained within an at-risk population relevant for stunting prevention interventions.

Despite these limitations, the findings provide important implications for program implementation. Community-based integrated behavioral interventions that are tailored to local environmental conditions and supported by repeated facilitation appear to be effective in improving caregiver practices. The integration of household hygiene education, particularly handwashing with soap, should be strengthened within routine nutrition counseling at Posyandu and primary health care services. Furthermore, group-based caregiver interventions and home mentoring approaches may be particularly effective in enhancing responsive caregiving practices, as reflected in the large effect size observed in this study. However, improvements in active feeding practices may require longer program duration and more intensive follow-up to achieve sustained behavioral change.

4. CONCLUSION

This study demonstrates that a community-based integrated behavioral intervention encompassing household hygiene practices, responsive caregiving, and active feeding practices can significantly improve caregiver behaviors among mothers of stunted children under five in the Kapuas River Basin community of Pontianak. Improvements were observed across all behavioral domains, with the greatest effect found in responsive caregiving, followed by household hygiene practices, and a smaller yet significant effect in active feeding practices. These variations suggest that caregiving interactions may be more responsive to short-term interventions, whereas feeding practices tend to require longer duration and sustained support to achieve optimal behavioral change.

Although this study did not directly assess child linear growth outcomes, the findings indicate that context-specific, integrated behavioral interventions have the potential to influence key proximal determinants of stunting risk in urban riverine settings. The integration of such interventions into routine Posyandu services may serve as a practical and scalable short-term strategy, particularly in areas facing infrastructural constraints.

Future studies are recommended to evaluate the long-term sustainability of these behavioral changes and to examine their impact on child nutritional status and growth outcomes.

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