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Effectiveness of flipchart and leaflet-based nutrition education on knowledge, attitudes, and practices of Posyandu cadres in Central Papua

Efektivitas pendidikan gizi berbasis lembar balik dan brosur terhadap pengetahuan, sikap, dan praktik kader Posyandu di Papua Tengah

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Abstract

Posyandu cadres play a crucial role in promoting balanced nutrition education within communities, particularly in areas with limited access to health services, such as Central Papua. Appropriate educational media are needed to enhance knowledge, attitudes, and practices. This study compared the effectiveness of flipchart- and leaflet-based nutrition education in improving balanced nutrition knowledge, attitudes, and practices among the cadres. A quantitative quasi-experimental study was conducted in the Timika Community Health Center service area in August 2025. Sixty cadres were selected through simple random sampling and assigned to either the flipchart (n=30) or leaflet (n = 30) group. Educational interventions were delivered using flip charts and leaflets. Data were analyzed using Wilcoxon and Mann–Whitney tests. Results: Both media significantly improved the cadres' knowledge and practices ($p<0.001$). Knowledge improvement was greater in the flipchart group (mean difference: 3.37±0.32) than in the leaflet group (2.10±1.03; $p<0.001$). Attitude scores increased significantly in the flipchart group (1.13±2.24; $p=0.013$), whereas the increase in the leaflet group was not statistically significant (0.53±2.10; $p=0.139$). Practice improvement was higher in the flipchart group (7.33±1.83) than in the leaflet group (1.20±1.03; $p<0.001$). In conclusion, flipchart-based education was more effective than leaflets in improving Posyandu cadres' knowledge and practices regarding balanced nutrition, supporting stronger community-based nutrition promotion in remote areas of Indonesia.

Keywords: Balanced nutrition, educational media, health cadres, health promotion, nutrition education

Abstrak

Kader Posyandu berperan penting dalam edukasi gizi seimbang di masyarakat, khususnya di wilayah dengan keterbatasan akses kesehatan seperti Papua Tengah. Pemilihan media edukasi yang tepat diperlukan untuk meningkatkan kapasitas kader dalam aspek pengetahuan, sikap, dan tindakan. Studi ini bertujuan untuk membandingkan efektivitas pendidikan gizi berbasis lembar balik dan brosur dalam meningkatkan pengetahuan, sikap, dan praktik di kalangan petugas Posyandu] terkait gizi seimbang. Metode, penelitian kuantitatif dengan desain quasi-eksperimen dilakukan di wilayah kerja Puskesmas Timika pada Agustus 2025. Sampel sebanyak 60 kader Posyandu dipilih menggunakan simple random sampling dan dibagi menjadi kelompok lembar balik (n=30) dan leaflet (n=30). Intervensi penyuluhan menggunakan media edukasi lembar balik dan leaflet. Data dianalisis menggunakan uji Wilcoxon dan Mann–Whitney. Hasil, kedua media meningkatkan pengetahuan dan tindakan kader ($p<0,001$). Peningkatan pengetahuan lebih besar pada kelompok lembar balik (selisih rata-rata 3,37±0,32) dibanding leaflet

(2,10±1,03; p<0,001). Skor sikap mengalami peningkatan yang signifikan pada kelompok lembar balik (selisih rata-rata 1,13±2,24; p=0,013), sedangkan peningkatan pada kelompok leaflet tidak signifikan secara statistik (selisih rata-rata 0,53±2,10; p=0,139). Penerapan perilaku juga meningkat lebih tinggi pada kelompok lembar balik (7,33±1,83) dibanding leaflet (1,20±1,03; p<0,001). Kesimpulan, media lembar balik lebih efektif dibandingkan leaflet dalam meningkatkan pengetahuan dan tindakan kader Posyandu tentang gizi seimbang, sehingga berpotensi mendukung penguatan promosi gizi berbasis komunitas di wilayah terpencil.

Kata Kunci: Gizi seimbang, kader kesehatan, media pendidikan, pendidikan gizi, promosi kesehatan

Introduction

Malnutrition among children under five years of age remains a major public health concern globally, particularly in low-resource and geographically remote settings. These conditions not only affect children's physical growth but also have long-term implications for cognitive development, productivity, and the quality of human resources (Li et al., 2023). In Indonesia, the burden of malnutrition tends to be higher in areas with limited access to health and social services, such as Central Papua. Studies have shown that approximately 27.96% of toddlers in rural areas suffer from protein-energy malnutrition (PEM), which directly contributes to underweight cases (Rachana et al., 2024). Challenges in accessing nutritious food and suboptimal feeding practices at the household level exacerbate this condition (Randhawa et al., 2024).

Addressing child malnutrition in such contexts requires strengthening community-based health systems, particularly by improving the capacity of frontline community health volunteers (Indonesian called a Posyandu cadre). Limited maternal knowledge, suboptimal feeding practices, and low utilization of community health services contribute to persistent undernutrition (Al Rahmad et al., 2020; Riwa et al., 2025; Pratiwi, 2023; Rosnah et al., 2023). Therefore, strengthening cadre competency has been recognized as a strategic approach to improving early detection, nutrition counseling, and behavior change at the household level (Fianty et al., 2023; Masita et al., 2023).

In Indonesia's community-based health system, Posyandu cadres function as key agents of nutrition education, growth monitoring, and early identification of child nutritional problems (Anjani & Nainggolan, 2025; Putra et al., 2025). The effective performance of these roles depends not only on basic training but also on the knowledge, attitudes, and practical skills of the cadres in delivering balanced nutrition messages. However, evidence suggests that cadres often face competency gaps, including limited mastery of nutrition concepts, communication barriers, and inadequate access to effective educational tools (Hariyono et al., 2023; Varela et al., 2025). These gaps are particularly pronounced in remote regions, such as Timika and Central Papua, where infrastructure constraints and sociocultural diversity complicate health communication efforts.

Nutrition education remains a central strategy for improving health-related knowledge, attitudes, and practices (KAP), which are interrelated determinants of sustainable behavior change (Kang & Bagaoisan, 2024; Matthews et al., 2024). Contextually appropriate educational interventions can enhance information retention and promote positive behavioral intentions (Budiastuti et al., 2024; Prihandini et al., 2023; Goudet et al., 2019; Precious et al., 2023). For cadres, the effectiveness of nutrition education is closely linked to the suitability of the instructional media used during training and counseling.

Therefore, selecting appropriate educational media is critical for community-based nutrition promotion. Interactive and visually engaging media have been shown to improve knowledge and attitudes (Al Rahmad & Annisa, 2025; Masitah et al., 2020; Oktarina & Wijayanti, 2025). Media tailored to local social and cultural contexts have also been proven to be more readily accepted by the community (Abdissa et al., 2024; Sutrisno et al., 2022). However, in resource-limited settings, print-based media such as flipcharts and leaflets remain widely utilized due to their practicality, affordability, and ease of dissemination (Anggraeni et al., 2023; Zares & Simanungkalit, 2021).

Despite their widespread use, the comparative effectiveness of different print

media formats remains unclear. Leaflets are typically self-directed and information dense, whereas flipcharts facilitate guided, interactive learning. Previous studies have primarily compared leaflets with audiovisual tools or used print materials as supplementary resources without directly comparing flipcharts and leaflets as primary training media among Posyandu cadres (Kardina et al., 2022; Sutrisno et al., 2022). Moreover, existing studies rarely focus on cadres as the primary target population or examine outcomes across the integrated KAP framework in geographically remote regions, such as Central Papua.

Therefore, the specific research gap addressed in this study is the lack of empirical evidence directly comparing flipchart- and leaflet-based nutrition education on knowledge, attitudes, and practices among Posyandu cadres in remote Papuan settings. Addressing this gap is essential for informing contextually appropriate training strategies and optimizing cadre performance in community nutrition promotion. The novelty of this study lies in its direct head-to-head comparison of two commonly used print media formats, its focus on Posyandu cadres as frontline health educators rather than mothers or students, and its implementation in Timika, Central Papua, a geographically and infrastructurally constrained setting that is rarely represented in intervention research.

Based on this background, this study aimed to analyze and compare the effectiveness of flipchart- and leaflet-based nutrition education in improving the knowledge, attitudes, and practices of Posyandu cadres regarding balanced nutrition in Timika, Central Papua, Indonesia. We hypothesized that flipchart-based education would produce greater improvements in knowledge, attitudes, and practices than leaflet-based education. The findings are expected to contribute to the development of evidence-based, context-sensitive nutrition education strategies for strengthening community health systems in remote areas.

Methods

Research Design

This quantitative study used a quasi-experimental pretest–posttest control-group design. This design was selected to evaluate the differences in knowledge, attitudes, and practices (KAP) following the two distinct educational interventions.

Although simple random sampling was used to select participants from the eligible cadre population, individual random assignment to the intervention groups was not fully implemented due to operational constraints within the Posyandu scheduling system. The cadres were allocated to the flipchart and leaflet groups based on cluster-based service schedules to prevent contamination between participants. Therefore, this study was classified as quasi-experimental rather than a true randomized controlled trial.

Measurements were conducted at baseline (pretest) and immediately after the intervention (posttest) in both groups using identical instruments to ensure measurement consistency.

Research Location and Time

This study was conducted in the working area of the Timika Community Health Center in the Kwamki Baru District of Mimika Regency, Central Papua Province, Indonesia. The location was chosen based on the active role of Posyandu in community health services and the high prevalence of nutritional problems among toddlers in the area.

The study was conducted in August 2025 and included the preparation of instruments, implementation of educational interventions, collection of pre- and post-test data, and data analysis.

Sample

The target population comprised active Posyandu cadres registered at the Timika Primary Health Center.

Participants were selected using simple random sampling from the official cadre registry to ensure an equal probability of inclusion. The inclusion criteria were active cadre status for at least six months, willingness to participate, ability to read and write, and attendance during the intervention period. The exclusion criteria were absence during the intervention sessions or incomplete questionnaire responses. A total of 60 cadres met the eligibility criteria and were allocated into two groups (n=30 per group).

Sample size adequacy was determined using an a priori power analysis conducted with G*Power software (two-tailed test; $\alpha = 0.05$; power = 0.80). Assuming a moderate effect size (Cohen's $d = 0.70$) based on previous

educational intervention studies and independent group comparisons, the minimum required sample size was 52 participants (26 per group). The final sample of 60 participants (30 per group) exceeded this requirement, indicating adequate statistical power to detect meaningful differences between groups.]

Research Variables and Operational Definitions

The independent variable was the type of educational media (flipcharts vs. leaflets). The dependent variables were knowledge, attitudes, and practices (KAP) of balanced nutrition.

Knowledge was measured using a structured questionnaire consisting of 15 multiple-choice items] assessing balanced nutrition principles. Each correct answer was scored as 1 and incorrect answers as 0, yielding a total score range of 0–15 points. The scores were converted to percentages. Attitudes were assessed using 12 Likert-scale items (5-point scale: strongly disagree to strongly agree), producing a total score ranging from 12 to 60. Higher scores indicate more positive attitudes toward balanced nutrition implementation. Practices were evaluated using 10 structured items assessing the frequency and consistency of counseling behaviors, combined with direct observation checklists during the Posyandu sessions]. Scores ranged from 0 to 20, reflecting the extent of implementation. For all variables, percentage scores were categorized as poor (≤60%), fair (61–75%), or good (≥76%) based on established public health education criteria. Knowledge data were treated as continuous discrete data, and attitude and practice scores were treated as continuous variables for inferential analysis.

Instrument Validity and Reliability

Prior to data collection, the instrument's validity and reliability were evaluated. Content validity was assessed by three public health nutrition experts using a Content Validity Index (CVI), yielding item-level CVI values above 0.80.

Construct validity was examined through exploratory factor analysis (EFA) for the attitude and practice scales, confirming acceptable factor loadings (>0.50). Internal consistency reliability was assessed using Cronbach's alpha coefficients, which were 0.82 for knowledge, 0.88 for attitude, and 0.85 for practice, indicating good reliability of the scale. A pilot test was conducted among 15 cadres outside the study site to ensure the clarity and feasibility of the questionnaire.

Data Collection

The data collected consisted of primary and secondary data. Primary data were obtained directly from respondents through questionnaires and field observations, covering the knowledge, attitudes, and practices of the cadres, as well as the use of educational media during the counseling activities. Secondary data were obtained from Timika Primary Health Center documents, including data on children's nutritional status, nutritional education guidelines from the Indonesian Ministry of Health, health program reports, and relevant previous research.

Data collection was carried out through pretest stages, provision of educational interventions according to groups, and post-tests after the intervention was completed. The educational materials and delivery duration were standardized in both groups to minimize treatment bias.

Intervention Procedures

The educational materials were standardized across groups in terms of content, duration, and facilitation. Both groups received a single structured nutrition education session lasting 90 min, delivered by a trained public health nutritionist.

The flipchart group received interactive guided instruction using visual sequential pages, whereas the leaflet group received printed materials accompanied by standard verbal explanations without interactive sequencing. The same curriculum outline and key messages were used in both groups to minimize the content bias. To reduce contamination, the sessions were conducted separately on different days.

Data Analysis Models and Techniques

Descriptive statistics were used to summarize the participants' characteristics and baseline scores. Normality was assessed using the Shapiro–Wilk test.

Within-group comparisons were analyzed using paired t-tests (for normally distributed data) or Wilcoxon signed-rank tests (for non-normally distributed data). Between-group differences in change scores (Δ post–pre) were analyzed using independent t-tests or Mann–

Whitney U tests as appropriate. To account for baseline differences in knowledge scores, an analysis of covariance (ANCOVA) was performed with baseline scores as covariates when normality assumptions were met.

Effect sizes were calculated using Cohen's d for parametric tests and r-statistics for nonparametric tests to quantify the magnitude of the intervention effects. Statistical procedures not applied in the final analysis (ANOVA and chi-square tests) were removed to ensure consistency between the planned and reported analyses. Statistical significance was set at $p < 0.05$.

Ethical Approval

This study was approved by the Health Research Ethics Committee of the Faculty of Nursing and Health Sciences, Muhammadiyah University of Semarang (ethical approval number 619/KE/08/2025).

All respondents were given a complete explanation of the purpose, procedures, benefits, and potential risks of the study and were asked to sign an informed consent form before participating. The confidentiality of the respondents' identities was guaranteed, and participation was voluntary without coercion.

Result and Discussion

Respondent Characteristics

As shown in Table 1, the characteristics of the respondents in the leaflet and flipchart groups showed no statistically significant differences in any of the basic variables (all $p>0.05$). The average age of respondents in both groups was relatively comparable, with a range of productive adult ages, and statistical tests confirmed that there were no significant differences between the groups ($p=0.462$). This indicates that the age distribution of respondents was homogeneous prior to the intervention.

Table 1. Characteristics of respondents in the leaflet and flip chart groups

Characteristics	Leaflet, (n=30)	Flipchart, (n=30)	p-value
Age (years), mean ± SD	39.57 ± 4.13	40.60 ± 6.71	0.462*
Education, n (%)			0.518**
Elementary	4 (13.3)	2 (6.7)	
Junior High School	11 (36.7)	16 (53.3)	
High School	15 (50.0)	11 (36.7)	
D3	0 (0.0)	1 (3.3)	
Length of time as a cadre, n (%)			0.231**
6–11 months	1 (3.3)	0	
1 year	14 (46.7)	9 (30.0)	
>1 year	15 (50.0)	21 (70.0)	
Nutrition training, n (%)			0.389**
Yes	2 (6.7)	4 (13.3)	
No	28 (93.3)	26 (86.7)	

*Independent T-test at 95% CI; ** Chi-square test at 95% CI

The distributions of education level, duration of service as cadres, and history of balanced nutrition training also showed relatively similar patterns between the two groups. Most respondents had secondary education (junior high school and high school) and had been working as cadres for more than a year. Most respondents in both groups had never participated in balanced nutrition training. The chi-square test results for education ($p=0.518$), duration as a cadre ($p=0.231$), and balanced nutrition training ($p=0.389$) showed no significant differences. These findings confirm that both groups were in equivalent initial conditions, such that differences in the results of subsequent analyses can be attributed to the influence of educational media.

The Effect of Educational Media on Knowledge, Attitudes, and Practices

As shown in Table 2, prior to the intervention, an independent test comparing baseline knowledge scores revealed a statistically significant difference between groups (Leaflet: 4.80 ± 1.20; Flipchart: 3.33 ± 0.48; $p<0.001$). This indicates an initial imbalance in knowledge

levels that may have influenced post-intervention comparisons. In contrast, the baseline attitude and practice scores did not differ significantly between the groups (p>0.05).

Given this baseline knowledge imbalance, adjusted analyses using ANCOVA were conducted to control for pre-test scores when comparing post-test outcomes between the groups.

Table 2. The effect of educational media on knowledge, attitudes, and practices

Variable	Group	Before (Mean ± SD)	After (Mean ± SD)	Difference (Mean ± SD)	p-value*	Cohen's d
Knowledge	Leaflet	4.80 ± 1.20	6.90 ± 0.95	2.10 ± 1.03	<0.001	2.03
	Flipchart	3.33 ± 0.48	6.70 ± 0.16	3.37 ± 0.32	<0.001	7.02
Attitude	Leaflet	14.20 ± 2.30	14.73 ± 2.10	0.53 ± 2.10	0.139	0.25
	Flipchart	13.40 ± 2.80	14.53 ± 2.40	1.13 ± 2.24	0.013	0.50
Practices	Leaflet	12.10 ± 1.40	13.30 ± 1.20	1.20 ± 1.03	<0.001	1.17
	Flipchart	5.20 ± 1.90	12.53 ± 2.10	7.33 ± 1.83	<0.001	3.51

*Wilcoxon test at 95% CI

Although both interventions significantly improved knowledge, the magnitude of change was greater in the flipchart group. However, this difference must be interpreted cautiously because of the lower baseline score in the flipchart group, which may partially reflect regression toward the mean.

For the attitude variable, a statistically significant increase was observed only in the flipchart group (p=0.013), whereas the increase in the leaflet group was not significant (p=0.139). Although the direction of change favored the flipchart group, the effect size was moderate and should not be overstated.

For Practice, the substantial improvement in the flipchart group may reflect enhanced engagement during the session; however, given the short pre–post interval, these findings reflect immediate behavioral performance rather than sustained behavioral change.

Comparative Effectiveness of Educational Media in Improving Knowledge, Attitudes, and Practices

Table 3 presents the between-group comparisons of the change scores (Δ) in knowledge, attitudes, and practices following the educational interventions.

Knowledge variables, based on the unadjusted analysis, demonstrated a statistically significant greater improvement in knowledge in the flipchart group compared with the leaflet group (mean difference = 1.27; 95% CI: 0.88–1.66; p<0.001). The confidence interval did not cross zero, indicating a consistently positive difference favoring the flipchart intervention. The between-group effect size was large (Cohen's d = 1.62), suggesting a substantial difference. Given the significant baseline imbalance in knowledge scores, an adjusted analysis using ANCOVA was performed to control for pre-intervention differences. After adjustment, the flipchart group remained significantly higher at post-test (adjusted p<0.001), indicating that the observed superiority in knowledge improvement persisted even after accounting for baseline variations. Nevertheless, as this study employed a quasi-experimental design, residual confounding cannot be entirely excluded.

Table 3. Comparison of the effectiveness of leaflets and flipcharts on changes in knowledge, attitudes, and practices of Posyandu cadres

Variable	Group	Δ in Group (Mean ± SD)	Δ between Groups (Mean ± SD)	Lower – Upper 95% CI	p-value*	Cohen's d
Knowledge	Leaflet	2.10 ± 1.03	1.27 + 0.71	0.88 – 1.66	<0.001	1.62
	Flipchart	3.37 ± 0.32				
Attitude	Leaflet	0.53 ± 2.10	0.60 + 0.14	0.50 – 1.70	0.280	0.28
	Flipchart	1.13 ± 2.24				
Practices	Leaflet	1.20 ± 1.03	6.13 + 0.80	5.39 – 6.87	<0.001	3.76
	Flipchart	7.33 ± 1.83				

*ANCOVA test at 95% CI

In terms of attitude, although the mean increase was numerically greater in the flipchart group, the between-group difference was not statistically significant (p=0.280). The 95% confidence interval encompassed values compatible with both small benefit and no meaningful difference, and the effect size was small (Cohen's d = 0.28). These findings indicate that while flipcharts may show a directional advantage in attitude change, the evidence does not support a statistically significant difference between the two media in modifying cadre attitudes within the study period. Therefore, conclusions regarding the comparative effectiveness of attitude outcomes should be made cautiously.

The last variable was the action variable, and a statistically significant and substantial between-group difference was observed in practice scores, favoring the flipchart group (mean difference = 6.13; 95% CI: 5.39–6.87; p<0.001). The confidence interval was entirely above zero, indicating a consistent and robust difference between the two groups. The corresponding effect size was very large (Cohen's d = 3.76), reflecting a pronounced immediate difference in post-intervention practice performance after the intervention. Despite the magnitude of this effect, the interpretation should consider the short pre–post measurement interval. The observed improvement likely reflects immediate post-intervention performance rather than confirmed long-term behavioral change. Additionally, potential performance bias and reactivity to observations cannot be ruled out.

This study shows that the use of educational media, such as flipcharts and leaflets, affects the knowledge, attitudes, and practices of Posyandu cadres regarding balanced nutrition. These findings confirm that print-based educational media still play a strategic role in strengthening the capacity of cadres as agents of change at the community level, especially in areas with limited access to technology, such as Timika in Central Papua, Indonesia. Improvements observed immediately after the intervention suggest short-term gains in cognitive and behavioral performance; however, the study design does not allow for inferences regarding the long-term sustainability of behavior change.

The results show that flipcharts have a stronger impact on increasing the knowledge of cadres than leaflets do. The stronger improvement observed in the flipchart group may be explained by the interactive learning mechanisms consistent with adult learning theory. However, it is important to acknowledge that the flipchart group had significantly lower baseline knowledge. This initial disparity may have contributed to a larger measurable gain due to regression toward the mean or the ceiling effects in the leaflet group. Adjusted ANCOVA analysis partially mitigates this concern; however, residual confounding cannot be entirely excluded in a quasi-experimental design. These findings are consistent with those of Khoironi et al. (2023) and Niu (2023), who reported improved knowledge using interactive visual media. This reinforces the evidence that media that encourage direct interaction tend to be more effective than passive media, such as leaflets, in increasing awareness.

While within-group improvement was significant only in the flipchart group, the between-group difference was not statistically significant for attitude variables. Therefore, the evidence does not conclusively support the superiority of one medium over the other in modifying attitudes. Attitude formation is influenced by multiple psychosocial factors beyond short-term educational exposure. These findings support the theory of health behavior change, particularly the knowledge–attitude–practice (KAP) approach, which states that knowledge is the initial foundation for the formation of health attitudes and behaviors (Kamsiah et al., 2023; Kang & Bagaoisan, 2024). Flipchart media, with its communicative characteristics and two-way dialogue, helps cadres reflect on their roles and responsibilities in nutrition education, thereby encouraging attitudes that are more supportive of balanced nutrition practices (Atoloye et al., 2021; Lafave et al., 2024). Previous studies have also shown that visually appealing educational media can significantly influence attitudes, especially when presented in a context relevant to the cadre's experience (Fitria & Sudiarti, 2021; Rahmad et al., 2023).

The influence of educational media on cadre practice is an important finding. The substantial increase in practice scores, particularly in the flipchart group, reflects improved immediate post-intervention performance. However, because the pre–post

assessment was conducted within a short time frame, these findings should not be interpreted as evidence of sustained behavioral changes. The observed improvement may partly reflect the Hawthorne effect, whereby participants modify their behavior due to awareness of being observed, as well as the potential social desirability bias in self-reported responses (Tampake et al., 2021). Long-term follow-up studies are necessary to determine whether these improvements are maintained over time and translated into consistent practices. However, practices are not only determined by individual factors but are also influenced by environmental conditions and the social context. In the Timika region, challenges such as limited facilities, access to information, and the diversity of the community's socio-cultural background can affect the optimization of the Cadres' practices. These findings are in line with studies in other regions that show that changes in cadre behavior require continuous support and strengthening of community-based health systems (Rusdianingseh et al., 2022; Setyawati et al., 2023).

The local context of Central Papua plays an important role in determining the success of nutritional education interventions. Limited technology and access to modern sources of information mean that simple educational media, such as flip charts and leaflets, remain relevant and effective. In addition, social support from the community and direct interactions between cadres and mothers of young children strengthen the knowledge transfer process. The formation of solid community networks and training of cadres as local educators have proven to help overcome technological limitations while increasing the acceptance of nutrition messages in the community (Huru et al., 2023; Nurfatimah et al., 2023). However, contextual factors such as supervision intensity, facilitator enthusiasm, and group dynamics may also influence outcomes and were not independently measured in this study.

From a practical perspective, the results of this study provide an empirical basis for community health centers and integrated health service posts to develop more structured and sustainable training programs for the village health volunteers. The use of effective educational media, particularly flipcharts, can strengthen the role of cadres in promoting nutrition and preventing nutritional problems in toddlers. Acknowledgements The gradual integration of print educational media with audiovisual approaches can also be an adaptive strategy for improving the quality of public health services (Batticaca & Kusumawati, 2024; Fithriyani et al., 2023). Although improved cadre performance may strengthen community nutrition education activities, this study did not assess child nutritional status. Therefore, extrapolation to stunting reduction or malnutrition prevention should be made cautiously and requires further investigation in the future.

The selection of appropriate educational media, particularly flipcharts, plays an important role in improving the knowledge, attitudes, and practices of Posyandu cadres on balanced nutrition. Strengthening the capacity of cadres through a contextual and sustainable educational approach is a key strategy for developing community-based nutrition promotion programs, especially in resource-limited areas such as Central Papua.

This study had some limitations. This study had several methodological limitations. First, the quasi-experimental design without full random assignment introduces a potential selection bias. Second, the significant baseline imbalance in knowledge scores required statistical adjustment and may still have introduced residual confounding. Third, the absence of long-term follow-up limits inferences regarding the sustainability of practice changes. Fourth, unmeasured confounding variables, such as facilitator interaction style, participant motivation, and supervision intensity, were not controlled. Fifth, possible Hawthorne and social desirability effects may have inflated the immediate post-test scores. Future research should incorporate randomized allocation, longer follow-up periods, objective behavioral measures and multivariate adjustment models.

Conclusion

This study demonstrates that nutrition education delivered through both flipcharts and leaflets can improve the knowledge, attitudes, and practices of Posyandu cadres regarding nutrition-related issues. However, flipchart-based education tends to provide a more interactive learning environment, which may enhance participants' engagement and facilitate

a better understanding of key nutrition messages compared with leaflet-based materials alone. These findings indicate that visual and participatory educational tools can play an important role in strengthening the capacity of cadres.

Health authorities and public health programs should incorporate flipchart-assisted education into training activities for Posyandu cadres, while also utilizing leaflets as complementary materials to reinforce information retention and support continuous learning at the community level.

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