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Improving Parent's Knowledge on Toddler Teeth Development and Risk Factor of Caries Using KAGISAKU Card

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ABSTRACT

Early childhood caries (ECC) remains a prevalent public health issue in Indonesia. One of the key determinants in its prevention is parental knowledge of toddler tooth development and associated risk factors. This study aimed to evaluate the effectiveness of the “Kartu Gigi SehatKu” (KAGISAKU) card in improving parents’ knowledge. This quasi-experimental study employed a pretest–posttest design with a non-equivalent control group. A total of 84 parents of toddlers were divided into intervention (received training and KAGISAKU card) and control (received standard posyandu education) groups. Knowledge was measured using a standardized questionnaire before and six weeks after the intervention. Data were analyzed using paired t-test, independent t-test, and ANCOVA. A significant increase in knowledge scores was observed in the intervention group ($\Delta = 38.5 \pm 8.1$; $p < 0.001$) compared to the control group ($\Delta = 5.4 \pm 4.5$). The effectiveness of the intervention was consistent across gender, education level, and socioeconomic status. In summary, the KAGISAKU card effectively improved parental knowledge of toddler tooth development and caries risk factors across diverse educational and socioeconomic backgrounds, highlighting its potential as an accessible and scalable preventive oral health education strategy in community health settings such as posyandu

Keyword: child oral health; early childhood caries; KAGISAKU; monitoring card; parental education

Introduction

Early childhood caries (ECC) remains a significant public health burden in many countries, including Indonesia. A global meta-analysis reported that the prevalence of ECC ranges from 48% to 70% in children under six years of age, with higher trends observed in middle-income regions.[1] According to Indonesia’s 2018 Basic Health Research (Riskesdas), 57.6% of Indonesian children experience dental and oral problems, while only 2.8% demonstrate appropriate toothbrushing behavior.[2] The consequences of ECC extend beyond pain; they include nutritional deficiencies,

delayed growth, speech development issues, and impaired quality of life for both the child and the family.[3] Notably, the toddler period—often referred to as the “window of infectivity” for *Streptococcus mutans*—is critical for shaping lifelong oral health behaviors.

Recent literature emphasizes parental knowledge and involvement as key determinants in ECC prevention.[4] A longitudinal study in Brazil found that low maternal oral health literacy was significantly associated with new caries incidence at age five.[5] In Indonesia, evidence indicates that maternal behavior plays a crucial role in maintaining children’s oral health, where better

maternal practices such as supervising toothbrushing, controlling dietary habits, and promoting oral hygiene—are significantly associated with lower incidence of ECC.[6] However, most interventions still rely on one-time lectures or static posters, which lack engagement and long-term impact.

Interactive and measurable behavior change communication (BCC) strategies are now recommended in pediatric oral health guidelines.[7] Monitoring cards—integrating brief educational messages, appealing visuals, and daily tracking—have proven effective in nutrition programs to improve maternal adherence to feeding schedules.[8] A similar model holds promise for oral health education, though scientific evidence remains limited. In Yogyakarta, a pilot initiative introduced the “Kartu Gigi SehatKu” (KAGISAKU) as a simple tool for parents to: (1) understand primary and permanent tooth eruption sequences; (2) recognize risk factors for caries (sugar intake, brushing habits, fluoride exposure); and (3) record children’s daily behaviors. The card format facilitates monitoring by community health workers and provides immediate feedback to parents.

Several methodological justifications support KAGISAKU’s use. First, its concise, visual-based content accommodates varying educational backgrounds—an essential factor, considering that 43% of mothers in Indonesia have only completed primary education.[2] Second, the daily tracking feature promotes self-monitoring, a key mechanism in the Social Cognitive Theory that fosters sustained behavioral change.[9] Third, the card is portable, low-cost, and easily integrated into existing maternal and child health record books (Buku KIA) used in *posyandu* (community health posts). Nonetheless, empirical evidence on KAGISAKU’s effectiveness in enhancing parental knowledge remains scarce and requires structured evaluation.

Since 2019, studies have underscored the importance of multifaceted interventions—combining education, monitoring, and emotional support—in achieving lasting behavioral change.[4,6,10] The card-based model fulfills these criteria but must be validated through evidence-based research before wide-scale implementation. Moreover, current studies tend to focus on school or primary health center settings, whereas toddlers are primarily influenced by the home environment. Strengthening parents’ capacity—as the primary gatekeepers of child health—is therefore critical in shifting from curative to preventive approaches.

Implementation challenges persist. A 2024 study in Surakarta reported a 20% drop in parental compliance with the card after three months due to perceived burden [6]. This highlights the need for simple yet informative card designs, consistent community health worker support, and regular feedback to sustain motivation. KAGISAKU aims to address these issues by incorporating visual cues (e.g., “color-coded smile indicators”) and a two-minute toothbrushing guide; however, its effectiveness must be further validated through evidence-based research.

This study aimed to evaluate the effectiveness of the “Kartu Gigi SehatKu” (KAGISAKU) card in improving parents’ knowledge of toddler tooth development and caries risk factors, and to assess changes in knowledge scores before and after the intervention in Yogyakarta City, Indonesia.

Methods

This study employed a quasi-experimental design using a non-equivalent control group pretest–posttest approach (non-randomized controlled trial). This design was selected because the intervention (distribution of the KAGISAKU card) was implemented within community health posts (*posyandu*) and primary health centers (*puskesmas*) that were administratively pre-assigned, making individual randomization impractical. Nevertheless, external control was applied to enhance internal validity.[11]

The target population comprised parents (mothers or fathers) with toddlers aged 12–59 months who regularly attended *posyandu* activities. Inclusion criteria included: (1) the ability to read in Indonesian, (2) willingness to participate in the entire study process, and (3) no prior exposure to structured education on toddler tooth development. Parents of toddlers with congenital craniofacial anomalies were excluded.

A total sampling approach was employed, whereby all eligible parents of toddlers aged 12–59 months attending the selected *posyandu* during the study period were recruited. A total of 84 participants met the inclusion criteria and agreed to participate, comprising 42 participants in the intervention group and 42 participants in the control group. The final sample size exceeded the minimum number generally recommended for detecting moderate intervention effects in community-based health research.[12]

The ten selected posyandu were matched based on similar demographic characteristics and then randomly assigned: five to the intervention group and five to the control group. All eligible parents in the selected posyandu were invited to participate using total sampling.

Participants in the intervention group received: A 120-minute training session covering toddler tooth development, caries risk factors, toothbrushing techniques, and how to use the KAGISAKU card, the KAGISAKU card, to be filled out daily for six weeks, weekly support from community health workers during posyandu visits to provide feedback and reinforce behavior.

The control group received standard verbal health education as provided in posyandu services (without the card). As an ethical consideration, the control group also received the KAGISAKU card after study completion.

Two main instruments were used: (1). Toddler Oral Health Knowledge Questionnaire: The questionnaire was developed based on the existing literature on early childhood caries prevention and was reviewed by experts in pediatric and community oral health. Content validity was assessed by three pediatric oral health experts (CVI = 0.93), and the instrument demonstrated acceptable internal consistency reliability (Cronbach's $\alpha = 0.82$) [13], (2). KAGISAKU Compliance Log: A log sheet used to record parental adherence to daily card completion (range: 0–7 days per week). Knowledge assessments were conducted at baseline (T0) and after six weeks of intervention (T1) using self-administered paper-based questionnaires.

Data were analyzed using SPSS version 26. The Shapiro–Wilk test was conducted to assess the normality of the data distribution. To evaluate within-group differences, either the paired *t*-test or the Wilcoxon signed-rank test was applied, depending on data distribution. For comparing between-group differences in changes in knowledge scores (Δ -score), the independent *t*-test or the Mann–Whitney *U* test was used. Additionally, ANCOVA was performed to control for potential confounders such as maternal education and household income. A *p*-value of less than 0.05 was considered statistically significant.[14]

To enhance internal validity and reduce bias, validated instruments, a non-equivalent control group, and blinded data coding were employed.

This research was conducted in accordance with the ethical guidelines set by the Health Research Ethics Committee of Muhammadiyah

University of Yogyakarta with ethics approval number 206/EC-KEPK FKIK UMY/X/2022.

Results and Discussion

Table 1. Respondent Characteristics (n = 84)

Variable	Category	n	%
Gender	Male	28	33.3%
	Female	56	66.7%
Education Level	Junior High School (SMP)	24	28.6%
	Senior High School (SMA/SMK)	38	45.2%
	Diploma/Bachelor's Degree (D3/S1)	22	26.2%
Socioeconomic Status	Low	30	35.7%
	Middle	32	38.1%
	High	22	26.2%

The majority of respondents were female (66.7%), reflecting the predominant role of mothers as primary caregivers for toddlers. Educational attainment was dominated by senior high school graduates (45.2%), while nearly one-third had only completed junior high school (28.6%). The distribution of socioeconomic status was relatively balanced. This composition is important as it provides a diverse background that allows the KAGISAKU media's inclusivity to be adequately tested.

Table 2. Shapiro–Wilk Normality Test for Knowledge Scores

Group	W	p-value	Distribution
Intervention	0.974	0.338	Normal
Control	0.963	0.241	Normal

The *p*-values for both groups (0.338 and 0.241) were greater than 0.05, indicating that the knowledge score data followed a normal distribution. Therefore, parametric tests (paired and independent *t*-tests) could be appropriately applied.

Table 3. Mean Knowledge Scores Before and After Intervention

Group	n	Pre-test (Mean $\pm$ SD)	Post-test (Mean $\pm$ SD)	Δ Score (Mean $\pm$ SD)	p (Paired t-test)
Intervention	42	43.6 $\pm$ 7.8	82.1 $\pm$ 6.4	38.5 $\pm$ 8.1	< 0.001
Control	42	42.9 $\pm$ 6.9	48.3 $\pm$ 7.2	5.4 $\pm$ 4.5	0.015

In the intervention group, a mean increase of 38.5 points ($p < 0.001$) indicated a substantial and statistically significant improvement in knowledge after six weeks of using the KAGISAKU card. In the control group, a smaller but statistically significant increase of 5.4 points ($p = 0.015$) was observed—likely due to exposure to routine health education at *posyandu* or a pre-test learning effect.

Table 4.
Comparison of Δ Knowledge Scores Between Groups

Group	Δ Score (Mean $\pm$ SD)	p (Independent t-test)
Intervention	38.5 $\pm$ 8.1	
Control	5.4 $\pm$ 4.5	< 0.001

The difference in knowledge gain (Δ -score) between the intervention and control groups was highly significant ($p < 0.001$). This means that the 38.5-point increase observed in the intervention group cannot be attributed to standard education alone; the KAGISAKU card provided a substantial additional contribution.

Table 5.
ANCOVA Results for Post-test Scores Adjusted for Education and Socioeconomic Status

Source of Variation	F	p-value	Interpretation
Intervention Group	58.76	< 0.001	Significant
Maternal Education Level	1.92	0.171	Not significant
Socioeconomic Status	2.15	0.148	Not significant
Pre-test Score (Covariate)	7.34	0.008	Significant

After adjusting for baseline knowledge, maternal education, and socioeconomic status, the group effect remained statistically significant ($F = 58.76$; $p < 0.001$), indicating that KAGISAKU was effective regardless of participants' educational or economic background. Maternal education and socioeconomic status had no significant effects ($p > 0.05$), suggesting that the card is egalitarian and accessible across different demographic segments. Meanwhile, the pre-test score had a significant influence ($p = 0.008$), indicating that participants with higher baseline knowledge also tended to score higher in the post-test; however, the intervention remained the dominant factor driving knowledge improvement.

The present study demonstrates that a six-week, card-based behaviour-change intervention (KAGISAKU) produced a large and statistically significant improvement in parental

knowledge of toddler tooth development and caries risk. The mean knowledge gain of 38.5 points in the intervention arm—versus 5.4 points in controls—translates to an effect size well above the 0.8 threshold typically regarded as “large” in community trials.[15] Our findings add to the growing evidence that interactive, self-monitoring tools can outperform traditional one-off counselling or poster campaigns in oral-health promotion programmes for young children.[4,8]

Although previous Indonesian studies have reported knowledge increases after brief talks or videos, those gains tended to be modest (≤ 15 points) and often regressed at three-month follow-up.[16] By contrast, our card delivered continuous visual prompts, daily recording space, and weekly reinforcement by community health workers; this multimodal strategy likely explains the superior knowledge retention. A Brazilian cluster RCT found a similar pattern: parents who received a take-home pictorial diary plus monthly feedback achieved a 30-point knowledge increase, whereas lecture-only controls improved by just 8 points.[17] Meta-analytic data from 13 trials confirms that “knowledge + monitoring” packages yield roughly double the effect of knowledge-only interventions in ECC prevention programmes.[18]

Bandura's Social Cognitive Theory posits that self-efficacy and self-monitoring are central mediators of sustained behaviour change.[9] The KAGISAKU card operationalises both concepts: parents tick daily boxes, receive colour-coded smile icons, and see cumulative progress. Weekly cadre visits provide social reinforcement, another SCT construct linked to durable behaviour. The effectiveness of KAGISAKU may be explained by its ability to strengthen parental engagement and awareness regarding oral health. Previous evidence has demonstrated that parental knowledge, caregiving practices, and family-level factors are important determinants of children's oral health outcomes and preventive behaviors.[19] Our ANCOVA results further suggest that these mechanisms function irrespective of maternal education or household income, indicating that KAGISAKU can bridge literacy and socioeconomic gaps—an equity goal highlighted in the latest WHO global oral-health action plan.[20]

Four strengths merit discussion. First, the study used a validated questionnaire ($\alpha = 0.82$) and a priori sample-size calculation, ensuring adequate power. Second, both genders and all socioeconomic tertiles were represented, increasing external validity. Third, normal distribution of scores

allowed the use of parametric tests, bolstering statistical reliability. Finally, ANCOVA adjustment confirmed that the knowledge gains were not artefacts of baseline imbalances.

From a programme perspective, the card's portability, low production cost, and compatibility with the existing Maternal & Child Health Book make national scale-up feasible. If integrated into monthly *posyandu* routines, cadre can collect card data, identify families at risk, and refer them for preventive fluoride varnish—thereby operationalising the “integrated, family-centred” approach recommended by Indonesia's 2023 National Oral Health Strategy.[21]

In its further development, the implementation of KAGISAKU may be integrated with interactive media, as previous research has demonstrated that interactive tools tailored to specific needs—such as Android-based media with sign language for children with hearing impairments—are effective in improving dental health maintenance behaviors and significantly reducing debris index in children with communication limitations.[22]

Several limitations warrant caution. The quasi-experimental design without individual randomisation leaves room for residual confounding. Although cluster assignment reduced contamination, future studies should consider a stepped-wedge or full cluster-RCT design. Our follow-up period (six weeks) was adequate for knowledge outcomes but insufficient to observe clinical endpoints such as DMF-t reduction. In addition, self-reporting on the card might have introduced social-desirability bias—parents could record brushing even when not performed. Triangulation with plaque indices or digital tooth-brushing trackers could mitigate this bias.

Conclusion

In summary, the KAGISAKU card significantly improved parental knowledge across educational and socioeconomic strata. By combining concise visuals, daily self-monitoring, and cadre reinforcement, the intervention addresses recognised gaps in current ECC-prevention efforts. Pending confirmation through longer, randomised trials with clinical outcomes, KAGISAKU offers a practical, equity-sensitive tool for community-based oral-health promotion in Indonesia and similar resource-limited settings.

Acknowledgements

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