

Use of Mobile Phone Text Messaging Versus Leaflets in Oral Health Education for Mothers of Preschool Children in an Urban Setting in Tanzania

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ABSTRACT

Introduction

Introduction: Oral health information forms the foundation of health promotion and disease prevention. Advances in information technology have created opportunities to enhance the delivery of health information beyond traditional educational approaches.

Purpose

This study aimed to examine and compare the effectiveness of providing oral health information through mobile phone text messages and printed leaflets on mothers' knowledge, oral health practices, and the oral hygiene status of preschool children.

Methods

This cluster-randomized controlled field trial was conducted among mother-child pairs of preschool children in Dar es Salaam, Tanzania. Participants received oral health information on preschool oral care over a two-week period through either printed leaflets or mobile phone short message service (SMS) messages, while the control group received routine care. The primary outcomes were mothers' oral health knowledge, oral health practices, and children's oral hygiene status. Data were analysed using SPSS version 25.0. Generalized estimating equations were used to compare the effects of the two interventions.

Results

A total of 132 mother-child pairs were randomized into three groups: control (38.6%, n = 51), leaflet intervention (32.6%, n = 43), and mobile phone SMS intervention (28.8%, n = 38). At baseline, the proportions of mothers with acceptable oral health knowledge and oral health practices, and children with good oral hygiene status, were 22.7%, 30.3%, and 33.3%, respectively. The model assessing children's oral hygiene status and mothers' oral health knowledge and practices demonstrated significant intervention-by-time interactions at follow-up for both the leaflet and SMS groups. The SMS intervention showed comparatively higher odds of improvement (OR = 10.7, 95% CI [4.5, 25.4]) than the leaflet intervention (OR = 7.3, 95% CI [3.2, 16.6]) and the control group (p = .001).

Conclusion

Provision of oral health information to mothers improved their oral health knowledge, oral health practices, and their children's oral hygiene status. Mobile phone SMS messaging demonstrated relatively greater improvements than leaflets and routine care, although the findings should be interpreted with caution. SMS-based oral health education may be a feasible approach for enhancing parental oral health literacy and promoting better oral health outcomes among preschool children.

INTRODUCTION

Health education comprises a combination of learning experiences designed to facilitate voluntary actions that promote health. Oral health education (OHE), in particular, forms the foundation of oral health promotion, disease prevention, and the maintenance of good oral health. Various traditional approaches are used to deliver oral health education, including lectures, visual aids, instructions, and hands-on demonstrations (Atif et al., 2024; Tusi et al., 2025). Oral health education activities are commonly conducted in dental clinics, Reproductive and Child Health Clinics (RCHCs), schools, and through mass media channels (Goldberg et al., 2022; Pelayo, 2025; Reza et al., 2024).

Despite their widespread use, traditional approaches have limitations in terms of relevance, timeliness, sustainability, and accessibility. The increasing availability of technology and access to digital devices, particularly mobile phones, has created new opportunities for delivering oral health education to diverse populations (Bastani et al., 2022; Çoğulu et al., 2025; Goldberg et al., 2022; Luai et al., 2024).

Providing parents with accurate and timely information regarding their children's dental needs plays a vital role in preventing current and future oral health problems (Sava-Rosianu et al., 2025). Oral health education for parents and caregivers is essential for ensuring effective routine oral care, facilitating access to dental services, improving adherence to treatment recommendations, and fostering positive attitudes towards oral health (Karamüftüoğlu et al., 2025). Parents should be equipped with knowledge regarding children's oral hygiene practices, timely dental consultations, support during and after dental visits, and the provision of appropriate oral healthcare materials and supplies (Krol & Whelan, 2023). Unfortunately, many parents remain unaware of important oral health issues, including the significance of primary teeth and recommended age-specific oral healthcare practices for children (Al-Namankany et al., 2025; Balakrishnan & Vadakkepurayil, 2023; Finlayson et al., 2019). Consequently, children of knowledgeable parents are more likely to adopt favourable oral health practices, which may positively influence their overall oral health status (Nepaul & Mahomed, 2020).

Although various methods, including television, radio, leaflets, and, more recently, mobile phones, have been used to deliver oral health education to communities, evidence suggests that many populations in developing countries remain inadequately informed about recommended oral care practices for children and the consequences of poor oral hygiene (Nepaul & Mahomed, 2020). Furthermore, the delivery of oral health education continues to face challenges related to resource limitations and disparities in knowledge. Previous studies have demonstrated that printed educational materials, such as leaflets, can be more effective than conventional approaches in improving oral health knowledge among caregivers of preschool- and school-aged children (Zacharias et al., 2019). Traditional mass media channels, including television and radio, have also been associated with increased oral health awareness because of their broad reach and popularity (Farrokhi et al., 2023). Other approaches that have been utilised include brochures, leaflets, mobile phone text messages, lectures, and interviews. More recently, internet-based platforms and social media have played an increasingly important role in health promotion and oral health education (Chen et al., 2022; Pelayo, 2025; Sharma et al., 2022).

There is limited evidence regarding the most effective methods for delivering oral health education to parents in many developing countries, including Tanzania. This study builds on the increasing accessibility of mobile phone technology in Tanzania and explores whether short message service (SMS) text messaging can serve as an effective medium for oral health education. Therefore, this study aimed to examine and compare the effectiveness of providing oral health information through mobile phone text messages and printed leaflets on mothers' knowledge, oral health practices, and the oral hygiene status of preschool children.

METHODS

Trial Design

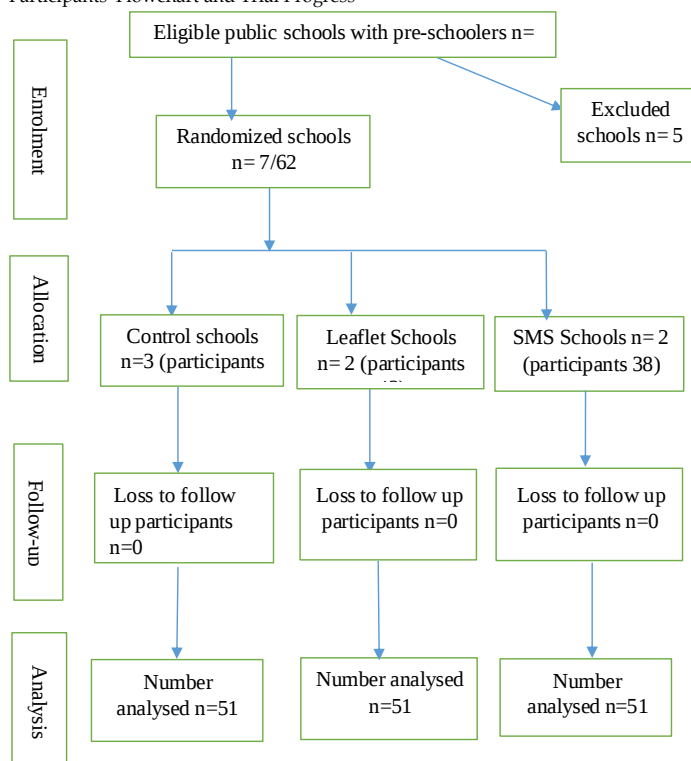
This study was a cluster-randomized controlled field trial among mothers and preschool children that examined the effectiveness of providing oral health information through mobile phone text messages and printed leaflets on mothers' knowledge, oral health practices, and children's oral hygiene status. Baseline data were collected before

participants were randomly allocated to one of three study arms: control, leaflet intervention, or mobile phone SMS intervention. Oral health education materials were delivered through either printed leaflets or SMS messages. Participants were followed for two weeks after the intervention, after which endpoint data were collected.

Ethical clearance was obtained from the Muhimbili University of Health and Allied Sciences (MUHAS) Institutional Review Board (IRB) (Approval no.: MUHAS-REC- 09-2021-847), and permission to conduct the study was obtained from the relevant municipal authorities.

This trial was registered with the Pan African Clinical Trials Registry (PACTR) under registration number PACTR202607713053712.

Figure 1:
Participants' Flowchart and Trial Progress



Participants

The participants were mother-child pairs, with children attending public preschools in Ubungo District, Dar es Salaam, Tanzania. The target population consisted of approximately 1.4 million children enrolled in public preschools nationwide in 2017 (The United Republic of Tanzania, President's Office—Regional Administration

and Local Government, 2017). Mothers were selected as the focal participants because they are typically the primary caregivers responsible for children's oral healthcare.

Participants were recruited from seven preschools randomly selected from 62 of the 67 eligible schools in Ubungo District. Five schools were excluded because they lacked formal registration. Randomization was performed using computer-generated permuted blocks of size seven with a 3:2:2 allocation ratio (control = 3; SMS intervention = 2; leaflet intervention = 2). Allocation concealment was ensured using sequentially numbered, opaque, sealed envelopes prepared by an independent statistician.

Based on a minimum sample size estimate of approximately 38 mother-child pairs per study arm, assuming 80% power, a baseline plaque prevalence of 60%, an expected post-intervention prevalence of 30%, and a 95% confidence level, approximately 120 mother-child pairs were required. Each school cluster was expected to contribute approximately 17 participants. Using systematic random sampling, 51 participants were allocated to the control arm, 43 to the leaflet arm, and 38 to the SMS arm (Figure 1). All participants completed the study.

The sample size was calculated at the individual level. Adjustment for clustering was not applied because reliable intraclass correlation coefficient (ICC) estimates could not be obtained owing to the small number of clusters, varying school sizes, and limited enrolment of preschool children in public schools.

Baseline imbalances were addressed using analysis of covariance (ANCOVA), with baseline values of the primary outcomes included as covariates. This approach enabled the evaluation of post-intervention differences while accounting for baseline variability.

Interventions

The intervention consisted of oral health messages focusing on children's oral care, delivered to mothers through two modalities: printed leaflets and mobile phone SMS messages. The educational content was based on recommendations from the American Academy of Pediatric Dentistry (AAPD) and was intended to improve

knowledge, motivation, and practical skills related to children's oral hygiene.

Specifically, mothers received information regarding parental assistance with toothbrushing, recommended brushing frequency and timing, systematic brushing of all tooth surfaces, and the use of fluoridated toothpaste. Participants in the SMS group received one text message daily for two weeks. Participants in the leaflet group received a coloured illustrated leaflet containing the same information immediately after baseline data collection. The control group received routine care only (Figure 2 and Text Box 1).

Figure 2:
Oral Health Leaflet



- i. Brush your child's teeth twice daily using fluoridated toothpaste.
- ii. Brush all tooth surfaces thoroughly.
- iii. Use a small, soft-bristled toothbrush.
- iv. Use a pea-sized amount of fluoridated toothpaste.

Box 1:
Oral Health SMS Message

FOR GOOD ORAL HEALTH:

Brush your child's teeth and tongue twice a day with a small, soft toothbrush and a pea-sized amount of toothpaste, and do not rinse the toothpaste off after brushing.

Outcome Measures

The primary outcomes were mothers' oral health knowledge, mothers' oral health practices regarding child oral care, and children's oral hygiene status.

Mothers' knowledge and practices regarding children's oral care were assessed using a structured questionnaire. Knowledge items included recommended toothbrushing supervision for children aged six years or younger, toothbrushing frequency, appropriate toothbrush type, recommended toothpaste quantity, and the importance of fluoride in toothpaste.

Responses were recoded into binary variables representing correct and incorrect answers. A composite knowledge score was computed by summing the five items. Participants who scored three or more correct responses were classified as having acceptable oral health knowledge.

Similarly, oral health practice items assessed whether mothers brushed their children's teeth, brushing frequency, toothbrush type used, toothpaste brand used in the household (later categorised as fluoridated or non-fluoridated/unknown), and the amount of toothpaste used. A composite practice score was calculated and subsequently dichotomised into acceptable and unacceptable oral health practices.

Children's oral hygiene status was assessed clinically using the modified Silness and L  e Plaque Index (Silness & L  e, 1964) on index teeth T16/55, T12/52, T36/75, and T32/72. Plaque scores were recorded as follows:

- 0 = No plaque
- 1 = Plaque confined to the gingival margin
- 2 = Moderate plaque accumulation
- 3 = Abundant soft deposits

For analysis, scores of 0 and 1 were categorised as good oral hygiene status, whereas scores of 2 and 3 were categorised as poor oral hygiene status.

Statistical Analysis

Data were entered and analysed using the Statistical Package for the Social Sciences (SPSS), version 25.0.

Sociodemographic characteristics, oral hygiene status, and mothers' knowledge and practices were summarised using frequencies and percentages. Chi-square tests were used to compare outcomes among the three study groups at baseline and follow-up.

To account for baseline imbalances in oral hygiene status and mothers' knowledge, analysis of covariance (ANCOVA) was performed. Follow-up measures were entered as dependent variables, intervention group as the fixed factor, and baseline measures as covariates. Effect sizes were reported using partial eta squared (η^2).

Generalized estimating equations (GEE) were used to assess the overall intervention effects on children's oral hygiene status, mothers' knowledge, and mothers' oral health practices. Analyses employed a binomial distribution, logit link function, and an unstructured correlation matrix.

Statistical significance was set at $p < .05$, corresponding to a 95% confidence level.

RESULTS

A total of 132 mother-child pairs participated in the study and were randomized into three study arms: control (38.6%, $n = 51$), leaflet intervention (32.6%, $n = 43$), and mobile phone SMS intervention (28.8%, $n = 38$). The mean age of the children was 5.33 years ($SD = 0.95$), while the mean age of the mothers was 33.91 years ($SD = 7.23$).

At baseline, 22.7% (30/132) of mothers had acceptable oral health knowledge, 30.3% (40/132) demonstrated acceptable oral health practices, and 33.3% (44/132) of children had good oral hygiene status.

Table 1: Baseline Sociodemographic Characteristics of Participants by Study Group (N = 132)

Variable	Category	Control <i>n</i> (%)	Leaflet <i>n</i> (%)	SMS <i>n</i> (%)	p-value
Child's sex	Male	27 (52.9)	26 (60.5)	21 (55.3)	.760
	Female	24 (47.1)	17 (39.5)	17 (44.7)	
Child's age (years)	< 6	23 (45.1)	23 (53.5)	13 (34.2)	.219
	6	28 (54.9)	20 (46.5)	25 (65.8)	
Mothers' age (years)	Younger mothers	30 (58.8)	26 (60.5)	18 (47.4)	.436
	Older mothers	21 (41.2)	17 (39.5)	20 (52.6)	
Mothers' education	Primary education or below	41 (80.4)	28 (65.1)	30 (78.9)	.188
	Secondary education or above	10 (19.6)	15 (34.9)	8 (21.1)	

Table 1 presents the distribution of participants' sociodemographic characteristics by study group. No

statistically significant differences were observed among the three groups with respect to child sex, child age, mothers' age, or mothers' educational attainment ($p > .05$), indicating comparable sociodemographic characteristics at baseline.

However, comparisons of outcome variables at baseline revealed statistically significant differences in children's oral hygiene status between study groups (Table 2). Consequently, baseline values were adjusted for in subsequent analyses.

Analysis of covariance (ANCOVA) demonstrated a significant effect of group allocation on post-intervention oral hygiene status, $F(2, 128) = 51.86$, $p < .001$, partial $\eta^2 = .448$, indicating substantial differences between the intervention and control groups after adjustment for baseline values. Baseline oral hygiene status was also a significant covariate, $F(1, 128) = 32.61$, $p < .001$, partial $\eta^2 = .203$, demonstrating that initial oral hygiene status influenced post-intervention outcomes.

Table 2: Distribution of Outcome Variables at Baseline and Follow-up by Study Group (N = 132)

Outcome Variable	Time Point	Control <i>n</i> (%)	Leaflet <i>n</i> (%)	SMS <i>n</i> (%)	p-value
Mothers with acceptable oral health knowledge	Baseline	6 (11.8)	13 (30.2)	11 (28.9)	.058
	Follow-up	4 (7.8)	25 (58.1)	30 (78.9)	.001
Children with good oral hygiene status	Baseline	10 (19.6)	15 (34.9)	19 (50.0)	.010
	Follow-up	4 (7.8)	27 (62.8)	34 (89.5)	.001
Mothers with acceptable oral health practices	Baseline	11 (21.6)	15 (34.9)	14 (36.9)	.219
	Follow-up	4 (7.8)	18 (41.9)	27 (71.1)	.001

Table 2 shows improvements in mothers' oral health knowledge, oral health practices, and children's oral hygiene status following the intervention. The greatest improvements were observed among participants who received mobile phone SMS messages, followed by those who received leaflets.

Compared with baseline values, the odds of mothers demonstrating acceptable oral health knowledge at follow-up were significantly higher in both the leaflet group ($OR = 7.3$, 95% CI [3.2, 16.6]) and the SMS group ($OR = 10.7$, 95% CI [4.5, 25.4]) than in the control group.

Similarly, the odds of children demonstrating good oral hygiene status at follow-up were significantly higher in both intervention groups, with a stronger effect observed in the SMS group (OR = 16.5, 95% CI [6.6, 41.2]) than in the leaflet group (OR = 6.5, 95% CI [2.7, 15.3]).

The odds of mothers demonstrating acceptable oral health practices were also significantly higher in the SMS group (OR = 6.9, 95% CI [3.6, 13.4]) than in the leaflet group and the control group. Across all outcome variables, improvements were greatest among participants who received SMS-based oral health education.

Table 3:
Generalized Estimating Equation Analysis of Intervention Effects on Oral Health Outcomes (N = 132)

Outcome Variable	Control (Reference)	Leaflet OR (95% CI)	SMS OR (95% CI)	p-value
Mothers with acceptable oral health knowledge	1.00	7.3 (3.2, 16.6)	10.7 (4.5, 25.4)	< .001
Children with good oral hygiene status	1.00	6.5 (2.7, 15.3)	16.5 (6.6, 41.2)	< .001
Mothers with acceptable oral health practices	1.00	3.5 (1.8, 6.8)	6.9 (3.6, 13.4)	< .001

The generalized estimating equation analysis demonstrated significant intervention effects for all outcome variables. Both educational interventions improved mothers' oral health knowledge, oral health practices, and children's oral hygiene status; however, the magnitude of improvement was consistently greater among participants who received mobile phone SMS messages.

DISCUSSION

This study evaluated the effectiveness of oral health education delivered to mothers of preschool children through mobile phone SMS messages and printed leaflets in an urban setting in Tanzania. The findings demonstrated improvements in mothers' oral health knowledge, oral health practices, and children's oral hygiene status following the intervention.

Most participants in the present study had relatively low educational attainment, with the majority having completed primary education or below. This characteristic may have enhanced the effectiveness of the intervention because participants were less likely to have previously received comprehensive oral health education.

Furthermore, the study was conducted in public preschools, which generally serve children from lower-income households. Similar findings have been reported by Namshitu Gideon et al. (2018) and Zacharias et al. (2019), who observed that 82.5% and 66.7% of mothers, respectively, had primary-level education or below.

The observed improvements in mothers' oral health knowledge, oral health practices, and children's oral hygiene status across the intervention groups support the importance of oral health education as a tool for promoting positive oral health behaviours and outcomes. Similar improvements following oral health education interventions have been reported among Finnish and Turkish parents (Sağlam et al., 2025; Tolvanen et al., 2016). When comparing the two intervention approaches, the odds of achieving acceptable oral health knowledge and oral health practices were consistently higher among mothers who received SMS messages than among those who received leaflets. Information delivered through mobile phones can be accessed repeatedly and may serve as a regular reminder, reinforcing health messages and promoting behaviour change. Similar positive effects of mobile phone text messaging on oral health literacy and oral health practices have been reported in previous studies (Al Bardaweel & Dashash, 2018; Çoğulu et al., 2025).

The greater improvement observed among mothers who received SMS messages may be attributable to the convenience, accessibility, and repeated exposure associated with mobile phone communication. Unlike printed materials, SMS messages can be reviewed repeatedly and may provide continuous reinforcement of key oral health messages. These characteristics may contribute to better retention of information and improved adherence to recommended oral health practices.

Nevertheless, the improvements observed among participants who received leaflets should not be underestimated. Printed educational materials remain a practical and potentially effective approach for oral health promotion, particularly in settings where access to mobile technology may be limited. The illustrated leaflets used in this study provided clear visual guidance and instructions

regarding children's oral care, which may have facilitated understanding and skill acquisition.

Findings from this study are consistent with those reported by Al Bardaweel and Dashash (2018), who found that educational leaflets contributed to improvements in oral health outcomes among children. The positive outcomes observed in both intervention groups suggest that the provision of oral health information, irrespective of delivery method, can enhance mothers' knowledge and practices and contribute to improved oral hygiene among preschool children.

The study also highlights the important role mothers play in influencing their children's oral health behaviours. Improvements in children's oral hygiene status following maternal exposure to oral health information reinforce the value of involving parents and caregivers in oral health promotion programmes aimed at young children.

Although the SMS intervention demonstrated greater effectiveness than leaflets, the findings should be interpreted within the context of the study design and duration. The intervention period was relatively short, and longer-term studies are needed to determine whether the observed improvements can be sustained over time.

Limitations

The intervention period was relatively short (two weeks), and the small number of clusters used for randomisation limited the statistical power of the study. Consequently, the precision of the estimated intervention effects was reduced, resulting in wide 95% confidence intervals. These limitations may affect the generalisability of the findings and indicate the need for larger cluster-randomised studies with longer intervention periods.

CONCLUSIONS

Provision of oral health information to mothers was associated with improvements in oral health knowledge, oral health practices, and children's oral hygiene status. Both intervention approaches demonstrated positive effects; however, mobile phone SMS messaging produced greater improvements than printed leaflets and routine care.

These findings suggest that SMS-based oral health education may be a feasible and effective approach for

enhancing oral health literacy among mothers and promoting positive oral health behaviours in preschool children. Further studies with longer follow-up periods are recommended to assess the sustainability of the observed effects.

Author Contributions:

- **Safaa Mohamed Chunga:** Conceptualization, Methodology, Investigation, Formal analysis, Writing – review & editing.
- **Hawa Shariff Mbawalla:** Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft, Writing – review & editing.
- **Febronia Kokulengya Kahabuka:** Conceptualization, Methodology, Writing – review & editing.

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Data Availability Statement: All data generated or analyzed during this study are included in this published article [and its supplementary information files]. Additional supporting data are available from the corresponding author upon reasonable request, subject to institutional policies.

Ethical Approval: Ethical approval for this study was obtained from the Muhimbili University of Health and Allied Sciences (MUHAS) Institutional Review Board (IRB). (Approval no.: MUHAS-REC- 09-2021-847).

Trial Registration: This trial was registered retrospectively with the Pan African Clinical Trials Registry (PACTR) under registration number PACTR202607713053712 on July 24, 2026 because the authors initially misallocated the trial as a local educational intervention exempt from registration. The authors confirm that all ongoing and related trials are registered.

Informed Consent: All participants provided informed consent prior to inclusion.

Conflicts of Interest: The authors declare that they have no conflicts of interest.

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