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Current Status and Innovative Interventions for Maternal and Child Oral Health in Primary Healthcare Settings: A Pilot Evaluation in Western China

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Abstract: Maternal and child oral health remains a critical yet underexplored aspect of public health, particularly in resource-limited primary healthcare settings. In Western China, socioeconomic and geographic challenges often result in inadequate preventive measures and limited access to oral healthcare services. This pilot evaluation aimed to investigate the current status of maternal and child oral health in primary healthcare facilities in Western China and to assess the feasibility of implementing innovative interventions to improve oral health outcomes. A cross-sectional survey was conducted in six community hospitals across rural regions of Western China. A total of 320 participants were recruited, including 120 pregnant women, 150 mothers of children aged 0–6 years, and 50 healthcare providers. Data were collected via structured questionnaires covering oral health knowledge, hygiene practices, and service utilization. An innovative intervention package—comprising tailored oral health education, nutritional guidance, and referral support—was then introduced. Pre- and post-intervention data were compared to evaluate changes in knowledge scores, oral hygiene behaviors, and routine dental visits. At baseline, the overall prevalence of dental caries among pregnant women and mothers was 44.1%, with pregnant women having a slightly higher rate (47.5%) than mothers (41.3%). Meanwhile, only 18.4% of participants reported regular dental visits. After the intervention, the mean oral health knowledge score increased from 4.5 ± 1.1 to 6.8 ± 1.3 ($p < 0.001$), and the proportion of routine dental visits rose from 18.4% to 35.9% ($p < 0.05$). Qualitative feedback from healthcare providers showed an 86.0% acceptance rate for the intervention package, although concerns about resource constraints and long-term sustainability were noted. This pilot study underscores the urgent need for targeted maternal and child oral health strategies in Western China's primary healthcare settings. The proposed innovative interventions demonstrated initial feasibility and effectiveness, meriting further large-scale, long-term investigations to validate and refine these approaches.

1. Introduction

Maternal and child oral health has increasingly been recognized as a pivotal component of public health initiatives, yet it remains underrepresented in preventive care policies, especially in resource-limited settings such as rural Western China [1]. Despite global awareness of the long-term consequences of poor oral health in mothers and children—including heightened risks of dental caries, gingival diseases, and adverse pregnancy outcomes—many primary healthcare facilities lack the infrastructure, trained personnel, and tailored educational programs needed to address these challenges effectively[2], [3].

Recent evidence suggests that targeted interventions, such as delivering oral health education during antenatal visits or integrating pediatric dental care into routine community check-ups, can significantly improve dental hygiene behaviors and reduce disease burden [4]. However, implementing these measures in primary healthcare settings is frequently constrained by a lack of financial and human resources, limited interprofessional collaboration, and insufficient policy support [5]. These gaps are particularly pronounced in Western China, where geographic barriers and socioeconomic factors further hinder access to care and continuity of dental services. Moreover, while a growing body of research highlights innovative approaches—such as mobile clinics, telehealth solutions, and multidisciplinary training programs—there remains a paucity of pilot evaluations that comprehensively assess the feasibility and preliminary outcomes of such interventions in localized contexts [6].

Against this backdrop, the present pilot study aims to fill the gap in current literature by investigating the status of maternal and child oral health in selected primary healthcare institutions in Western China and by examining the feasibility of a novel intervention package. Specifically, we propose to (1) assess baseline knowledge, practices, and service utilization; (2) implement tailored educational and nutritional guidance programs; and (3) evaluate short-term improvements in dental behaviors and acceptance among healthcare providers. Results from this study are intended to inform larger-scale initiatives and guide future policy development to sustainably elevate oral health standards for mothers and children in underserved regions.

2. Materials and Methods

2.1 Study Design and Setting

This study was conducted as a pilot cross-sectional intervention designed to evaluate the current status of maternal and child oral health and assess the feasibility of an innovative intervention in under-resourced primary healthcare facilities. The research took place between September 2024 and February 2025 in six community hospitals located in rural areas of Western China. Site selection was based on patient volume, basic oral health service availability, and willingness of hospital administrators to participate [7], [8].

2.2 Participants and Sampling

A total of 320 participants were recruited:
(1) 120 pregnant women (gestational age 12–36 weeks),
(2) 150 mothers of children aged 0–6 years,
(3) 50 healthcare providers (including dentists, nurses, and community health workers).

We employed a convenience sampling strategy with partial stratification. Pregnant women and mothers were consecutively enrolled during routine antenatal or pediatric visits. Healthcare providers were included to capture varied perspectives on delivering oral health interventions within primary

care settings [9].

2.3 Inclusion Criteria

a) Pregnant women aged ≥18 years in the second or third trimester.
b) Mothers (≥18 years) with at least one child aged 0–6 years.
c) Healthcare providers (physicians, dentists, nurses, or community health workers) who had worked at the selected hospitals for ≥6 months.
Willingness to provide written informed consent and complete study procedures.

2.4 Exclusion Criteria

a) Presence of severe systemic diseases that could hinder study participation.
b) Inability to communicate effectively in Mandarin.
Refusal to participate in post-intervention follow-up.

2.5 Ethical Considerations

This study was approved by the Ethics Committee of North Sichuan Medical College (approval number: NSMC20241201). All participants provided written informed consent prior to enrollment, following the principles outlined in the Declaration of Helsinki[10], [11]. To protect confidentiality, each participant was assigned a unique identification code; no personally identifiable information was recorded.

2.6 Intervention

An innovative, multi-component intervention was developed based on existing evidence and adapted to local contexts. The intervention included oral health education sessions highlighting proper toothbrushing techniques, regular use of fluoride toothpaste, and recognition of early dental caries symptoms. Additionally, targeted nutritional guidance was provided, emphasizing the importance of low-sugar, balanced diets specifically tailored to the nutritional needs of pregnant women and young children, with recommendations reflecting local dietary practices. To facilitate timely and appropriate clinical care, a simplified referral system was also established, enabling participants to access specialized dental services more efficiently. Furthermore, healthcare providers received specialized training on effectively utilizing the referral system and managing patients requiring advanced oral health care.

2.7 Data Collection

A structured questionnaire was administered to collect information on sociodemographic characteristics, oral health knowledge, hygiene practices, and service utilization:

• **Sociodemographic Information**: Age, education level, household income, pregnancy status, or child's age.

• **Oral Health Knowledge and Practices**: Adapted from a previously validated questionnaire[12]. Participants reported brushing frequency, fluoride toothpaste usage, and barriers to routine dental care.

• **Baseline Clinical Assessment**: Dental staff performed basic oral examinations following World Health Organization (WHO) criteria to identify dental caries and signs of gingival inflammation [13].

• **Post-Intervention Follow-Up**: Conducted 8 weeks after the intervention to reassess knowledge scores, changes in hygiene practices, and frequency of routine dental visits.

Additionally, semi-structured interviews were conducted with healthcare providers to evaluate feasibility and acceptance of the intervention. Interview topics included perceived barriers, resource requirements, and suggestions for program improvement.

2.8 Outcome Measures

a) **Knowledge Score**: Ten multiple-choice questions on oral hygiene and dietary impact, with a maximum score of 10.

b) **Routine Dental Visit Rate**: The proportion of participants undergoing at least one routine dental check-up before and after the intervention.

c) **Oral Hygiene Behaviors**: Self-reported brushing frequency, use of fluoride toothpaste, and child-oriented oral care practices.

d) **Feasibility and Acceptance**: Qualitative feedback from healthcare providers regarding resource adequacy, training needs, and perceived sustainability.

2.9 Statistical Analysis

All quantitative analyses were performed using IBM SPSS Statistics (Version 26.0; IBM Corp., Armonk, NY, USA). Descriptive statistics (means and standard deviations for continuous variables; frequencies and percentages for categorical variables) summarized baseline characteristics.

• **Paired t-tests** (or Wilcoxon signed-rank tests if assumptions of normality were not met) were used to compare knowledge scores before and after the intervention.

• **Chi-square tests** examined changes in categorical outcomes (e.g., dental visit rates).

• **Thematic analysis** was employed to interpret qualitative data from healthcare provider interviews, following an inductive coding approach.

A two-sided p-value < .05 was considered statistically significant for all tests.

3. Results

3.1 Baseline Characteristics

A total of 320 participants were included in this study, comprising 120 pregnant women (37.5%), 150 mothers of children aged 0–6 years (46.9%), and 50 healthcare providers (15.6%). Table 1 presents the overall sociodemographic profile and oral health status across these three groups.

In terms of age distribution, pregnant women were, on average, 27.8 ± 4.2 years old, whereas mothers were slightly older at 29.1 ±4.7 years. Healthcare providers were notably older, with a mean age of 34.5 ±5.3 years. Regarding education, around 42.5% of pregnant women and 36.0% of mothers had a high school education or lower, compared to only 6.0% among healthcare providers—94.0% of them reported holding at least a college diploma. For monthly household income, nearly half of both pregnant women (49.2%) and mothers (52.7%) reported earnings between 3,000 and 6,000 CNY.

Notably, 41.7% of pregnant women and 39.3% of mothers had untreated dental caries; in contrast, data were not collected for healthcare providers in this regard. Moreover, only 10.0% of pregnant women and 15.3% of mothers had undergone a routine dental check-up in the past 12 months, whereas 62.0% of healthcare providers had done so. The average duration of professional service among healthcare providers was 5.3 ±3.2 years.

Table 1. Baseline Characteristics of Study Participants (N = 320)

Variable	Pregnant Women (n = 120)	Mothers (n = 150)	Healthcare Providers (n = 50)	Total (N = 320)
Proportion of Total (%)	37.5	46.9	15.6	100.0
Age (years, mean ± SD)	27.8 ± 4.2	29.1 ± 4.7	34.5 ± 5.3	-
Education Level, n (%)				
High School or Lower	51 (42.5)	54 (36.0)	3 (6.0)	108 (33.8)
Diploma / Bachelor's	61 (50.8)	84 (56.0)	31 (62.0)	176 (55.0)
Graduate or Above	8 (6.7)	12 (8.0)	16 (32.0)	36 (11.3)
Monthly Income (CNY), n (%)			-	
< 3,000	36 (30.0)	44 (29.3)	-	80 (-)
3,000–6,000	59 (49.2)	79 (52.7)	-	138 (-)
> 6,000	25 (20.8)	27 (18.0)	-	52 (-)
Untreated Dental Caries, n (%)	50 (41.7)	59 (39.3)	-	109 (34.1)
Dental Check in Past 12 Months, %	10.0	15.3	62.0	-
Years in Practice (mean ± SD)	-	-	5.3 ± 3.2	-

Notes:
1. "–" indicates that the variable does not apply to a given group.
2. Percentages may not sum exactly to 100% due to rounding.
3. CNY = Chinese Yuan.

3.2 Oral Health Knowledge Scores

Building on the baseline data presented in Section 3.1, the overall analysis revealed substantial improvements in oral health knowledge across all three participant groups following the intervention (Table 2, Figure 1). Pregnant women and mothers, who started from relatively low baseline scores (4.5 ± 1.1 and 4.4 ± 1.2, respectively), showed notable gains ($p < 0.001$), reaching post-intervention means of 6.8 ± 1.3 and 6.9 ± 1.4. Qualitative feedback indicated that these maternal groups became more attentive to preventive strategies, including proper brushing techniques and the routine use of fluoride toothpaste, which may help reduce the risk of early-childhood caries. Although healthcare providers already had a higher baseline score (6.5 ± 1.4), they still demonstrated a modest but statistically significant increase to 7.2 ± 1.3 ($p = 0.015$). This improvement, albeit smaller in magnitude, suggests that the specialized training components—emphasizing patient education and referral support—could further refine service quality in primary healthcare settings. Overall, these findings underscore the effectiveness of targeted oral health education, dietary guidance, and referral pathways in enhancing knowledge levels for both maternal participants and healthcare professionals, ultimately contributing to better maternal and child oral health outcomes.

Table 2. Oral Health Knowledge Scores Before and After Intervention (mean ± SD)

Group	Pre-intervention	Post-intervention	p-value
Pregnant Women (n = 120)	4.5 ± 1.1	6.8 ± 1.3	< 0.001
Mothers (n = 150)	4.4 ± 1.2	6.9 ± 1.4	< 0.001
Healthcare Providers (n = 50)	6.5 ± 1.4	7.2 ± 1.3	0.015

Notes:
1. Scores range from 0 to 10, with higher scores indicating better oral health knowledge.
2. p-values were derived from paired t-tests or appropriate non-parametric equivalents.
3. The intervention included oral health education, dietary guidance, and referral support, as detailed in the Methods section.

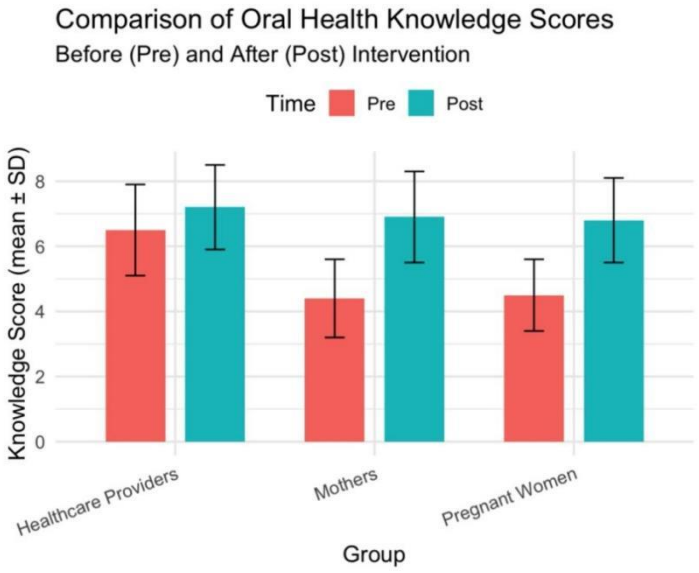

Figure 1. Comparison of oral health knowledge scores (mean ± SD) before (Pre) and after (Post) intervention among pregnant women (n=120), mothers (n=150), and healthcare providers (n=50). Error bars represent standard deviations. Statistical significance was determined by paired t-tests ($p < 0.05$).

3.3 Changes in Oral Hygiene Behaviors

The intervention not only enhanced oral health knowledge but also led to significant improvements in daily oral hygiene practices among the study groups (Table 3, Figure 2). As illustrated in Figure 2, subfigure 2A displays a marked increase in the proportion of participants reporting daily brushing (≥2 times/day), with pregnant women rising from 33.3% to 55.8% ($p < 0.001$) and mothers from 35.0% to 57.3% ($p < 0.001$), which likely reflects a growing awareness of the impact of oral infections on pregnancy outcomes and early childhood caries. Similarly, subfigure 2B shows that fluoride toothpaste usage increased significantly in both groups ($p < 0.001$). Moreover, the proportion of mothers who supervised their children's brushing improved from 28.0% to 49.3% ($p < 0.01$). Although healthcare providers already maintained a relatively high baseline in both daily brushing (72.0%) and fluoride usage (40.0%), they also demonstrated further improvements post-intervention ($p < 0.05$), underscoring the importance of modeling exemplary oral hygiene practices. Together, these behavioral changes confirm the effectiveness of the targeted educational and motivational components of the intervention and suggest that a stronger emphasis on family-level oral care—particularly among mothers—may yield lasting benefits for maternal and child health.

Table 3. Changes in Oral Hygiene Behaviors Before and After Intervention

Group	Daily Brushing ≥2 Times/Day (Pre/Post)	p-value	Fluoride Toothpaste Usage (Pre/Post)	p-value	Child Brushing Supervision (Pre / Post)	p-value
Pregnant Women (n=120)	33.3%/55.8%	< 0.001	15.8%/39.2%	< 0.001	- / -	-
Mothers (n=150)	35.0%/57.3%	< 0.001	18.7%/42.0%	< 0.001	28.0%/49.3%	0.008
Healthcare Providers (n=50)	72.0%/80.0%	0.044	40.0%/50.0%	0.048	- / -	-

Notes:

1.Daily Brushing ≥2 Times/Day: Proportion of participants reporting brushing at least twice per day.

2.Fluoride Toothpaste Usage: Proportion of participants regularly using fluoride-containing toothpaste.
3.Child Brushing Supervision: Proportion of participants assisting or supervising a child's toothbrushing at least once daily; not applicable (shown as "–") for pregnant women and healthcare providers.
4.p-values derived from Chi-square or Fisher's exact tests, as indicated in the Methods section.

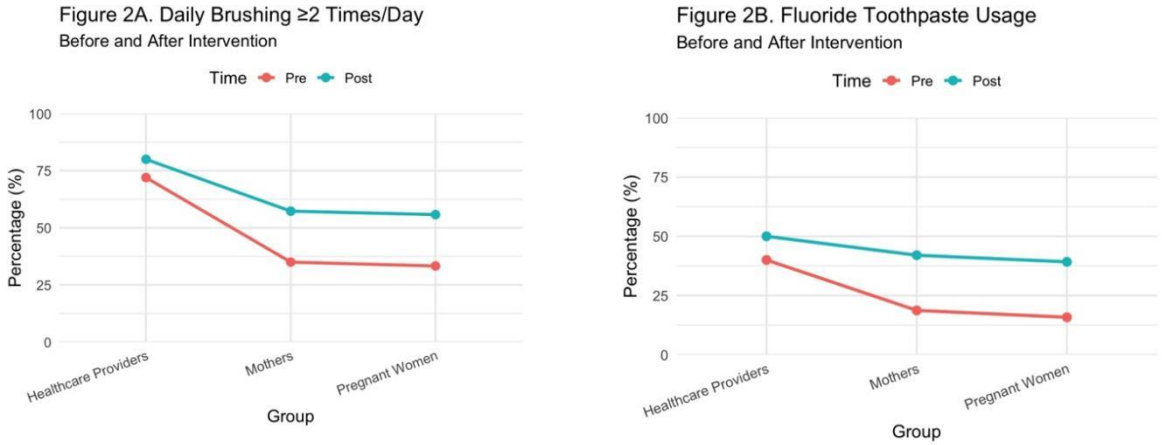

Figure 2. Changes in Oral Hygiene Behaviors Before and After Intervention

3.4 Uptake of Routine Dental Visits

The intervention also led to significant improvements in the uptake of routine dental visits across all groups (Table 4). Among pregnant women, the proportion attending a routine check-up in the six months prior to the intervention was only 10.0%, which increased markedly to 28.3% post-intervention ($p < 0.001$), suggesting that enhanced awareness of the potential impact of oral infections on pregnancy outcomes boosted their confidence in seeking dental care. Similarly, mothers exhibited a significant increase from 15.3% to 33.0% ($p < 0.001$), with many reporting that a heightened concern for their children's oral health motivated them to schedule preventive appointments for themselves. Although healthcare providers began with a relatively high baseline of 62.0%, this figure further rose to 75.0% ($p = 0.016$), as they acknowledged the benefits of professional reminders and the importance of self-care. Collectively, these results indicate that the combined educational, motivational, and referral-support components of the intervention effectively fostered a routine practice of preventive dental care, which may yield enduring benefits for maternal and child oral health.

Table 4. Changes in Routine Dental Visits (Pre / Post) Over a Six-Month Interval

Group	Pre (%)	Post (%)	p-value
Pregnant Women (n = 120)	10.0	28.3	< 0.001
Mothers (n = 150)	15.3	33.0	< 0.001
Healthcare Providers (n = 50)	62.0	75.0	0.016

Notes:
1. "Routine dental visit" refers to at least one preventive check-up within the specified six-month interval.
2. Intervention components included oral health education, dietary advice, and an enhanced referral pathway.

3.5 Qualitative Feedback and Intervention Acceptance

In addition to the quantitative assessments presented above (Sections 3.1–3.4), semi-structured interviews were conducted with all 50 healthcare providers to further explore the feasibility and acceptance of the intervention. Using a thematic analysis approach, four main themes emerged (Table 5):

1) Increased Awareness and Motivation

Many providers reported a heightened sense of responsibility regarding maternal and child oral health. One dental practitioner stated, "I realized that simple advice on brushing and fluoride use can make a significant difference for pregnant women and young families."

2) Resource Constraints

Despite recognizing the intervention's value, some providers cited limited staffing and materials as barriers to widespread implementation. One community nurse noted, "We can't always give each patient a full demonstration due to time pressure and a shortage of educational leaflets."

3) Enhanced Collaboration and Referral

A majority of participants mentioned that the simplified referral pathway streamlined care for more complex cases. "Referring patients to higher-level facilities for severe dental issues has never been this straightforward," commented a senior nurse, emphasizing improved teamwork.

4) Sustainability Concerns

While most providers expressed optimism about maintaining oral health education components, there were concerns about long-term funding and policy support. One interviewee remarked, "Unless there's a clear budget and ongoing training, it's hard to keep the momentum."

These qualitative findings indicate that, although the intervention was generally well-received, structural challenges—such as limited resources and uncertain policy backing—may affect its long-term viability. Nonetheless, the positive reception and reported impact on clinical practice suggest potential scalability, provided adequate support mechanisms are established.

Table 5. Thematic Analysis of Healthcare Providers' Feedback (n = 50)

Main Theme	Summary of Feedback	Representative Quote
Increased Awareness and Motivation	Heightened responsibility and recognition of oral health impact; improved provider confidence	"I realized that simple advice on brushing and fluoride use can make a big difference."
Resource Constraints	Shortage of staff, materials, and time for thorough education sessions	"We can't always give each patient a full demonstration due to time pressure…"
Enhanced Collaboration and Referral	Simplified referral pathway, improved interprofessional communication	"Referring patients has never been this straightforward; now we have a clear protocol."
Sustainability Concerns	Need for long-term funding, training, and policy support to sustain intervention	"Without dedicated budget and ongoing training, it's hard to keep the momentum going."

Notes:

1. Interviews were carried out after the intervention, focusing on feasibility, acceptance, and perceived barriers.
2. The quotes have been edited for clarity but retain the original intent of each participant.

4. Discussion

This study demonstrated significant improvements in maternal and child oral health knowledge, oral hygiene behaviors, and the uptake of routine dental visits among pregnant women, mothers, and healthcare providers following a targeted educational and motivational intervention implemented in primary healthcare settings in Western China. The findings underscore the importance and effectiveness of structured educational programs combined with targeted motivational and referral-support measures in improving oral health practices at the community level.

Consistent with recent literature, our findings showed significant increases in oral health knowledge among participants, particularly among pregnant women and mothers[14]. Such improvements are essential as better knowledge directly influences healthier practices and behaviors.

Notably, the substantial knowledge gains translated effectively into tangible behavior change, underscoring the effectiveness of tailored education and targeted communication strategies in driving behavioral modifications [15].

Behavioral indicators, including daily brushing frequency, fluoride toothpaste use, and parental supervision of children's brushing, all exhibited considerable improvements. These results align with existing evidence suggesting that targeted educational interventions can significantly improve oral hygiene behaviors in vulnerable populations[16]. Particularly, the rise in fluoride toothpaste use and brushing frequency is critical, given fluoride's proven effectiveness in preventing dental caries and reducing the oral disease burden [17], [18]. The significant increase in parental supervision of children's brushing behaviors among mothers highlights the broader implications of our educational component in extending behavioral changes beyond individual participants to the family unit, potentially providing a sustainable approach to oral disease prevention.

Moreover, uptake of routine dental visits notably increased across all three study groups. This finding is especially important as regular dental attendance is strongly associated with improved oral health outcomes and reduced incidence of severe oral diseases [19]. Interviews conducted alongside quantitative assessments revealed that heightened awareness about the systemic implications of oral infections motivated these behavior changes, particularly among pregnant women who previously might have avoided dental services due to misconceptions or fear. The improvements observed among healthcare providers also underscore the value of professional role modeling and its potential to further reinforce community-wide behavioral changes.

However, despite promising outcomes, several limitations should be acknowledged. The current study utilized a relatively small sample size, limiting generalizability. Furthermore, the absence of a control group restricts the ability to definitively attribute observed improvements solely to the intervention. Future research incorporating randomized controlled designs and larger sample sizes is recommended to validate and generalize these findings.

In conclusion, the pilot intervention successfully enhanced oral health knowledge, hygiene practices, and routine dental care utilization among pregnant women, mothers, and healthcare providers in primary healthcare settings. The observed behavioral changes suggest that such community-focused educational and motivational interventions could play a crucial role in reducing oral health disparities, particularly among vulnerable populations. Policymakers and healthcare planners should consider integrating similar structured educational programs within primary healthcare systems to effectively improve maternal and child oral health outcomes.

5. Conclusion

This pilot intervention significantly improved oral health knowledge, daily hygiene practices, and uptake of routine dental visits among pregnant women, mothers, and healthcare providers in primary healthcare settings. Key findings include substantial increases in daily brushing frequency, fluoride toothpaste usage, parental supervision of child toothbrushing, and regular dental check-ups. These improvements highlight the effectiveness of targeted educational and motivational strategies in promoting oral health behaviors. Such interventions could play a crucial role in reducing oral health disparities, particularly in maternal and child populations. Future research should explore the long-term sustainability of these behavioral changes and assess the feasibility of integrating similar interventions into routine primary healthcare services at a broader scale.

6. Limitations

Despite the promising outcomes, this study has several limitations. First, as a pilot evaluation conducted in primary healthcare settings in western China, the sample size was relatively small, and

participants were recruited from specific geographic areas, potentially limiting the generalizability of the findings. Second, due to the short-term follow-up of six months, the sustainability of the behavioral improvements observed remains uncertain. Additionally, the lack of a randomized control group could have introduced selection bias, reducing the strength of causal inference. Lastly, some indicators, such as parental supervision of child toothbrushing, were exclusively assessed among mothers, which limits the scope of behavioral analysis within households.

7. Future Directions

Future studies should address these limitations by employing larger sample sizes with randomized controlled designs to enhance generalizability and causal validity. Longer follow-up periods are needed to examine the sustainability and long-term effectiveness of oral health interventions. Moreover, expanding the target populations to include fathers and other family caregivers would offer a more comprehensive assessment of household-level oral health behaviors. Further research could also evaluate the feasibility and cost-effectiveness of integrating similar oral health interventions into broader public health programs and routine primary healthcare services, particularly focusing on resource-limited settings.

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