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**Original Article**

# Evaluating Household-Based Oral Health Interventions Delivered by Community Health Workers Under Average Psychosocial Conditions

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## ABSTRACT

Psychosocial stress within the household has been associated with how often children brush their teeth. Community health worker (CHW) programs that address psychosocial challenges in vulnerable communities have likewise been connected to shifts in various health behaviors. Examine longitudinal changes in psychosocial factors and explore the relationship between these factors and the dose of community health worker (CHW) intervention received among families living in urban Chicago. A total of 420 families were enrolled from 10 community clinics and Infants, Children and 10 Women (WIC) centers across Cook County, Illinois, to take part in a clinical trial. At baseline, 12 months and 6 months, research staff gathered caregiver-reported psychosocial measures—including family functioning, and levels of depression, anxiety, social support, and social functioning—as well as details about the CHW-delivered oral health visits, such as the number of visits, topics covered, and child participation. After each home visit, CHWs documented their field observations concerning the household setting, social conditions, stressors, and available supports. Across the sample, participants generally reported psychosocial measures that aligned with population-average levels on nearly all indicators, and these values remained stable throughout the study period. Social functioning was the only domain rated below average, with scores of 32.0 (6.9), 32.1 (6.7), and 32.7 (6.9) at baseline, 6 months, and 12 months, respectively, compared to a population mean of 50 (SD = 10). No notable differences in social functioning over time were detected based on the number of CHW visits received (control group and those receiving 0–4 visits). CHW field notes, however, highlighted a variety of psychosocial stressors linked to economic hardship, language challenges, and immigration-related issues. The finding that psychosocial measures appeared average and remained stable over time—despite CHW field notes indicating substantial stressors related to poverty, limited support, immigration challenges, and language barriers—suggests that our study may not have effectively captured key social determinants influencing oral health behaviors, or that measurement limitations may have led to inaccurate reporting. Upcoming research will use a broader set of tools to evaluate psychosocial elements such as social support, anxiety, depression, trauma, functioning, and resilience within this urban population. In addition, we plan to examine neighborhood-level indicators of distress and resilience to more fully integrate the social ecological framework into understanding child oral health behaviors.

**Keywords:** Oral health, Psychosocial stress, Community health worker, Childhood, Social determinants of health, Parenting

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## Introduction

Early childhood caries is the most widespread chronic condition affecting children and remains a major contributor to racial and ethnic inequities in oral health. Although tooth decay develops through multiple pathways, caregiver and child behavior plays a central role. Community health workers (CHWs) have emerged as a promising workforce for implementing behavior-focused interventions by strengthening social support, building self-efficacy, enhancing self-management, and improving knowledge about oral disease [1-4]. CHWs may also play a meaningful role

in addressing household psychosocial challenges that can influence behavior change [1].

The (CO-OP) Coordinate Oral Health Promotion Chicago study was a cluster-randomized behavioral trial that employed CHWs to improve oral health knowledge and self-management skills with the aim of modifying young children's oral health practices [5]. Conducted in urban communities across Chicago, the study assessed children's tooth brushing by caregiver-reported brushing frequency and clinical plaque evaluation. Contrary to expectations and to findings from other CHW research, the home-based intervention did not yield improvements in brushing compared to a wait-list control group [6]. This unexpected result prompted additional analyses to better understand why behavior change did not occur.

Social ecological theory highlights how health behaviors are shaped simultaneously by factors at the individual, relational, organizational, community, and societal levels [7, 8]. Caregiver psychosocial strain—often documented as symptoms of depression or anxiety—is known to limit engagement with behavioral interventions and has been associated with children's brushing practices [9-13]. CHWs influence health behaviors by offering social support, helping families navigate services, and advocating on their behalf [14]. While they are not mental health professionals, they can help families identify and address social hardships that contribute to psychosocial stress and can connect families to mental health services when needed [15, 16]. We therefore explored whether caregivers' psychosocial stressors might help explain the limited behavioral impact of CO-OP and whether the intervention effectively modified intermediate social support pathways.

Grounded in Bandura's Social Cognitive Theory [17], the CO-OP intervention assumed that caregiver engagement in children's tooth brushing could be shaped by timely, supportive feedback from CHWs positioned outside but aligned with the family's social network [6]. Previous work links tooth brushing practices—including supervision—to caregiver self-efficacy [18, 19]. According to Bandura, self-efficacy develops through repeated successful experiences, observing others, encouragement, and emotional regulation. The CHW curriculum aimed to strengthen self-efficacy by offering support and instruction to help caregivers build confidence in managing their children's oral health. CHWs were also trained to assist families in navigating structural barriers such as poverty, limited access to dental services, and immigration-related difficulties—factors that have been associated with poor oral health behaviors and outcomes in children [20-22].

This secondary analysis was designed to investigate whether the CHW oral health intervention was related to caregiver and household psychosocial stressors and social support within an urban Chicago sample. The study aimed to (1) describe changes in psychosocial measures over time and (2) evaluate whether psychosocial factors were associated with the amount of CHW intervention families received.

## Materials and Methods

*Study population*

The (CO-OP) Coordinated Oral Health Promotion Chicago study was a cluster-randomized controlled trial designed to assess whether CHWs could improve tooth brushing practices among low-income urban children younger than three years old. A total of 420 families were enrolled between January 2018 and February 2019 from 10 community health clinics and 10 Infants, Women, and Children (WIC) sites across Cook County, Illinois. Of these, 211 families were assigned to the intervention arm, which included four CHW-delivered oral health home visits over a 12-month period. Details on the study methodology, procedures, and approaches have been published elsewhere [5].



*Covariates*

Participant data were collected by research staff at baseline, 6 months, and 12 months. Family functioning was evaluated using the Confusion, Hubbub, and Order Scale (CHAOS), a validated instrument [23]. Caregiver psychosocial characteristics were measured using the Patient-Reported Outcomes Measurement Information System (PROMIS) [24], including domains such as depression, anxiety, social support (emotional, informational and instrumental), and social functioning, defined as the caregiver's ability to engage in social roles and activities.

The number of completed CHW visits served as both an indicator of intervention exposure and a reflection of the family's capacity to attend scheduled appointments. Following each home visit, CHWs documented details in a centralized database, including the topics addressed, the level of participant engagement, the number of adult and child participants, and the action plan developed during the visit. When children were present, CHWs categorized their engagement with the intervention as "A lot," "A little," or "Not at all."

*CHW intervention*

The CHW-led intervention consisted of up to four home visits over the course of one year, with CHWs maintaining a degree of social proximity to participants [6]. Spanish-speaking families in CO-OP were paired with Spanish-speaking CHWs. The four CHWs were all female, aged 26–33 years; two identified as Latina and were bilingual in Spanish and English, one as African American, and one as West African. During the initial visit in most households, CHWs conducted a Caries Risk Assessment for both the child and caregiver [25], which informed the content and focus of subsequent CHW-delivered interventions. After each visit, CHWs followed up with caregivers via telephone.

The intervention drew on social cognitive theory to support families in identifying and modifying oral health behaviors [17]. CO-OP CHWs applied structured self-management skills—including patient-provider collaboration, problem solving, resource utilization, decision making, and action planning—to address core oral health curriculum topics, such as basic tooth anatomy, factors contributing to disease, early childhood caries, nutrition, fluoride, tooth brushing techniques, and oral health recommendations [26-29]. CHWs also received training in psychosocial health, including mental health first aid and motivational interviewing, supervised by a clinical psychologist who met with CHWs at least every two months, or more frequently as needed, to address challenges encountered during visits, such as household stressors, poverty-related issues, or rare participant safety concerns.

When barriers to delivering oral health education were identified, CHWs guided caregivers in applying relevant self-management skills and developing an Action Plan. Families created lists of problems, which informed their Action Plans. At subsequent home visits and follow-up calls, CHWs reviewed previous Action Plans, revising them or creating new ones as appropriate. When children were present, CHWs engaged them in oral health education through interactive games and activities **(Figure 1)**. There was also the option to record clinical observations, such as visible cavities, fillings, white spots, or enamel defects, based on CHW and family comfort. CHWs documented their observations in journals after visits; entries were maintained without linking to participant identifiers.




**Figure 1.** Child-focused oral health education. CHW-led oral health interventions for children incorporated interactive, play-based activities designed to teach topics such as proper tooth brushing techniques and healthy dietary habits.

Intervention exposure was quantified by the total number of completed visits per family throughout the study. CHWs were also encouraged to keep journals to document their observations and reflections from home visits. These field notes were subsequently reviewed and discussed during meetings with both CHWs and the research team.

*Human subjects*

The trial received approval from the Institutional Review Boards of the Chicago Department of Public Health (protocol 16-06), the University of California San Francisco (protocol 16-19920) and the University of Illinois at Chicago (protocol 2017-1090). Written informed consent was obtained from all caregivers. Oversight was provided by a Data Safety Monitoring Board, an independent external monitor who reported to the funding agency, and a Community Advisory Board.

*Analysis*

PROMIS results are presented as T-scores, standardized to a mean of 50 and a standard deviation of 10 in the original calibration sample; higher values reflect greater levels of the attribute assessed. The minimal important change (MIC) is defined as the smallest individual-level shift over time that a person perceives as a meaningful difference in that domain. For non-surgical treatments, reported MIC thresholds typically fall between 2 and 6 points [30].

Because oral health practices did not differ between families who received the community health worker (CHW) visits and those who did not, we graphed psychosocial trends over time for the entire study sample combined. To explore any link between psychosocial variables and CHW exposure, we first summarized visit content descriptively, showing how often each participant discussed particular topics and the overall number and variety of topics covered across the four possible visits.

We created line graphs of PROMIS social functioning scores across study time points, separated both by randomization group (control vs. intervention) and by actual number of CHW visits completed (none, one, or two-to-four). Psychosocial outcomes are displayed as means (±SD) and also as medians with full range and interquartile range (25th–75th percentiles). Given the low variability in the data, no further inferential modeling was performed to examine either changes in psychosocial measures over time or their relationship with CHW visit dose. All analyses were carried out in SAS/STAT version 9.4 (Cary, NC, USA).

## Results and Discussion

*Study participants*

The CO-OP study enrolled 420 children along with one of their caregivers. The children had a mean age of 21.6 months (SD 6.9). Most families were low-income and identified as either Hispanic or non-Hispanic Black. Detailed demographic information for CO-OP participants has been published previously [5].

*Intervention delivery*

Of the 420 households enrolled in the study, 211 were assigned to the intervention group. The intervention period spanned from April 2018 to February 2020. During this time, a total of 420 CHW visits were completed, involving 365 unique children and adults. Mothers were the primary adult participants, attending 387 visits (92.1%). Other family members and household participants also attended, including sisters (N = 70, 16.7%), brothers (N = 56, 13.3%), fathers (N = 56, 13.3%), grandparents (N = 35, 8.3%), cousins (N = 11, 2.6%), aunts or uncles (N = 17, 4.0%), and other household members present during the visit—such as caregiver friends, great-grandmothers, stepfathers, god-sisters, partners, guardians, or unknown individuals (N = 18, 4.3%). Children took part in 347 of the intervention visits, representing 83% of the total. Across all four visits, most children demonstrated consistently high levels of engagement in the intervention activities **(Figure 2)**.

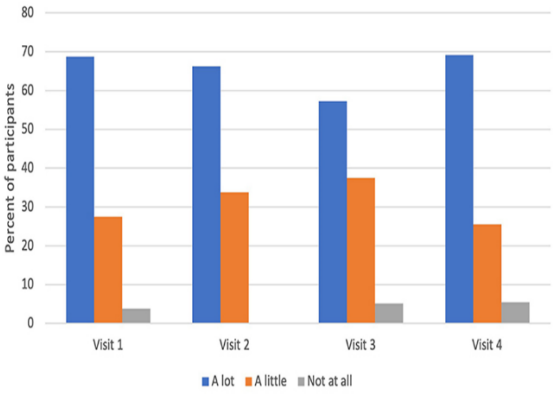


**Figure 2.** Child engagement during CHW intervention visits. Across all four CHW visits, child participation remained consistent, with most children present during a visit showing high levels of engagement with the CHW.

Regarding intervention exposure, nearly one-quarter of families in the intervention arm received all four scheduled visits (23.7%), 12.8% received three visits, 23.2% received one visit, 21.3% received two visits, and 19.0% did not receive any visits during the study period [6]. The duration of CHW visits varied widely, ranging from 9 to 195 minutes, with an average length

of 63.7 minutes (SD 21.8) [6]. After each visit, CHWs attempted follow-up phone calls. Across the 12-month period, 8.5% of participants received four calls, 28.4% received one, 10.9% received three, 19.0% received two, and 33.25% did not receive any follow-up calls.

Most visits were conducted in participants' homes (N = 391, 93.1%), although a small number occurred at alternative locations, including clinics (N = 1, 0.2%), WIC centers (N = 9, 2.1%), or other sites such as grandparent homes, public libraries, parks, supermarkets, and a tattoo shop (N = 19, 4.5%).

*Intervention content*

Caregivers and CHWs focused discussions on topics most relevant to each household. Nearly all participants covered fundamental oral health topics with CHWs, including fluoride, tooth brushing and oral health basics (**Table 1**). Other key oral health behaviors, such as nutrition (88.9%), weaning (87.1%) and dental visits (95.3%) bottle were also frequently addressed. In addition, caregivers and CHWs explored social determinants affecting the child's oral health, including insurance coverage, housing, financial assistance, immigration status, childcare and mental health. (**Table 1**).

**Table 1.** Oral health topics covered by oral community health workers.

| Topic | Participants who received the topic at least once (out of 171) | Times the topic was addressed across all visits (out of 420) |
|---|---|---|
| **Oral health basics** | 169 (98.8%) | 261 (62.1%) |
| **Tooth brushing** | 169 (98.8%) | 382 (90.9%) |
| **Fluoride** | 169 (98.8%) | 324 (77.1%) |
| **Weaning from bottle at night** | 149 (87.1%) | 259 (61.7%) |
| **Nutrition** | 152 (88.9%) | 318 (75.7%) |
| **Dental visit** | 163 (95.3%) | 352 (83.8%) |
| **Other topics*** | 132 (77.2%) | 261 (62.1%) |

Other issues discussed by participants with CHWs included insurance immigration, coverage, mental health, financial assistance, child support, childcare, housing, physical activity, general health or medical concerns, and access to social resources.

The largest proportion of participants focused on tooth brushing and fluoride, with 169 individuals (98.8%) addressing these topics during CHW visits. Fluoridated water was the most frequently covered oral health subtopic, reaching the same 169 participants (98.8%). Additional commonly discussed subtopics included dental visit regularity, frequency of foods and drinks, brushing frequency, and other spontaneously raised topics. CHWs were trained to allow participants to bring up social issues they perceived as relevant to their child's oral health. These issues arose for 132 participants (77.2%) and were discussed a total of 261 times across visits 1–4 (62.1%). The topics reflected broader social determinants of oral health, such as insurance, general health concerns, immigration, mental health, childcare, financial assistance, child support, housing, social resources and physical activity [31].

*Psychosocial factors*

Psychosocial factors showed no significant change across time points **(Table 2)** and did not differ between study arms. Levels of perceived stress and social support were similar to those reported in the general population [31], with the exception of social functioning. Caregivers in the CO-OP arm exhibited markedly lower social functioning scores—approximately two standard deviations below the population norm—at all assessment points [32.0 (SD 6.9) at baseline, 32.1 (SD 6.7) at 6 months, and 32.7 (SD 6.9) at 12 months; population norm = 50 (SD 10)]. When social functioning at 12 months was examined by community health worker (CHW) visit dose, no dose–response relationship emerged; in fact, participants who received zero (mean 33.4, SD 6.6) or only one (mean 33.9, SD 6.3) CHW visit reported slightly higher social functioning than those who received two (mean 32.5, SD 7.1), three (mean 33.2, SD 6.9), or three-to-four (mean 33.0, SD 8.3) visits **(Figure 3)**. Because psychosocial variables remained stable over time and showed no arm or dose effects, no additional analyses were performed.



**Table 2.** Caregiver and household psychosocial stress levels over time.

| Outcome | Baseline (n=422) | 6 months (n=366) | 12 months (n=362) |
|---|---|---|---|
| **Anxiety (PROMIS T-score)** | | | |
| **Mean ± SD** | 46.6 ± 8.1 | 46.7 ± 8.4 | 46.9 ± 8.2 |

| | | | |
|---|---|---|---|
| **Median (min–max; IQR)** | 40.3 (40.3–77.9; 13.4) | 40.3 (40.3–81.6; 13.4) | 40.3 (40.3–81.6; 13.4) |
| **Depression (PROMIS T-score)** | | | |
| **Mean ± SD** | 46.2 ± 6.9 | 45.7 ± 6.8 | 45.7 ± 6.5 |
| **Median (min–max; IQR)** | 41.0 (41.0–71.2; 10.8) | 41.0 (41.0–79.4; 8.0) | 41.0 (41.0–69.4; 10.8) |
| **Ability to participate in social roles & activities (PROMIS T-score)** | | | |
| **Mean ± SD** | 32.0 ± 6.9 | 32.1 ± 6.7 | 32.7 ± 6.9 |
| **Median (min–max; IQR)** | 31.3 (25.9–58.2; 10.3) | 31.3 (25.9–55.7; 11.0) | 31.3 (25.9–58.2; 11.8) |
| **Emotional support (PROMIS T-score)** | | | |
| **Mean ± SD** | 55.9 ± 8.9 | 56.0 ± 8.8 | 56.6 ± 8.3 |
| **Median (min–max; IQR)** | 57.8 (24.7–63.5; 14.3) | 60.7 (32.5–63.5; 14.3) | 63.5 (24.7–63.5; 14.3) |
| **Informational support (PROMIS T-score)** | | | |
| **Mean ± SD** | 57.7 ± 9.8 | 58.0 ± 10.0 | 59.1 ± 9.5 |
| **Median (min–max; IQR)** | 58.7 (27.1–69.1; 17.9) | 58.7 (23.7–69.1; 19.0) | 60.3 (31.8–69.1; 16.7) |
| **Instrumental support (PROMIS T-score)** | | | |
| **Mean ± SD** | 54.8 ± 9.3 | 55.2 ± 9.4 | 55.5 ± 9.5 |
| **Median (min–max; IQR)[a]** | 55.4 (31.1–65.6; 18.4) | 55.4 (31.1–65.6; 18.4) | 55.4 (27.0–65.6; 18.4) |
| **Household chaos (CHAOS total score, mean item)** | | | |
| **Mean ± SD** | 2.3 ± 0.6 | 2.3 ± 0.6 | 2.3 ± 0.6 |
| **Median (min–max; IQR)** | 2.2 (1.0–4.5; 0.8) | 2.2 (1.0–4.2; 1.0) | 2.3 (1.0–4.3; 1.0) |

A total of 419 participants completed the PROMIS Informational survey at baseline. The PROMIS T-score has a reference population mean of 50, with a standard deviation (SD) of 10. Higher T-scores indicate greater levels of the concept being measured. Minimal important change (MIC) refers to the change within an individual over time that is perceived as a meaningful improvement or worsening in the measured domain. For non-surgical interventions, MIC values ranging from 2 to 6 points have been reported. SD stands for standard deviation, and IQR denotes interquartile range.

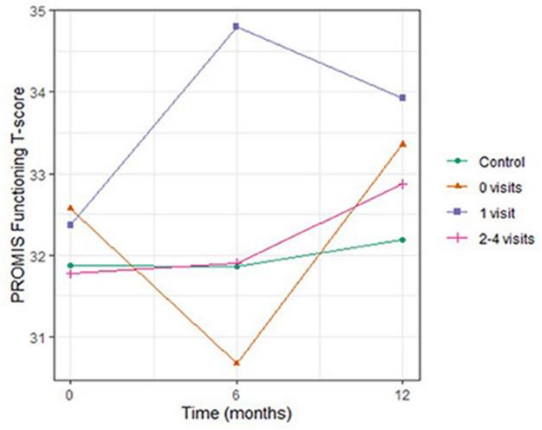


**Figure 3.** Changes in Social Functioning Over 12 Months in Urban Chicago Households with Young Children by Community Health Worker Visit Frequency



PROMIS social functioning scores were monitored over a one-year period for participants. Those in the control group did not receive any community health worker (CHW) interventions. In the intervention group, scores for social functioning remained largely stable throughout the study. Further analysis based on the number of CHW visits showed no meaningful differences in social functioning scores between participants, and trends over time were similar across all subgroups.

*CHW observations*

Community health workers (CHWs) documented their interactions and observations following intervention visits. Although these observations were not guided by specific hypotheses, they are presented as ethnographic insights to complement the main study outcomes. CHW journal entries highlighted levels of environmental and psychosocial stress that sometimes did not align with participants' quantitative self-reports. Even when caregivers reported anxiety, depression, or social support levels similar to the general population, CHWs noted that many faced substantial psychosocial challenges while managing daily life and caring for their children.

CHWs were trained to assist families with navigating the healthcare system, such as helping schedule dental appointments. They frequently encountered barriers tied to limited resources and support, which made everyday tasks—like picking up medications during inclement weather—more difficult. One CHW wrote:

"During a visit on a rainy day to a caregiver of twin babies, I collected the medication for her since I was not allowed to provide a ride. I also helped with transportation and gave her my umbrella. The caregiver shared the challenges she faces getting to appointments."

Concerns about immigration and potential deportation heightened anxiety for some caregivers and occasionally interfered with maintaining health insurance. A CHW noted:

"A caregiver canceled her children's insurance due to fears stemming from immigration issues and news reports about families seeking medical or social benefits."

Although the primary focus of home visits was oral health, caregivers often discussed additional stressors, including financial insecurity, language difficulties, and limited social and informational support. Financial pressures were intensified when support networks were lacking or when language barriers prevented access to assistance. One CHW recorded:

"Her biggest concern was mounting bills. Feeling desperate and unsure of whom to contact regarding debts in collections, she was most worried about navigating these issues due to the language barrier."

In our study, caregivers reported consistently low levels of social functioning that did not improve over time, indicating that our CHW-led intervention may not have adequately addressed this key determinant of health. Other psychosocial measures were reported at levels comparable to the general population, which was surprising. These factors also remained stable throughout the study period. The combination of unexpectedly average scores and lack of change suggests that the intervention may not have fully captured or influenced the social determinants affecting oral health behaviors. While our psychosocial instruments are validated for national populations, they may not fully reflect the realities of low-income, urban caregivers with young children. PROMIS tools, for instance, can be affected by differential item functioning, where responses may reflect characteristics such as ethnicity/race rather than the intended construct [32]. Qualitative data, however, revealed that families experienced meaningful psychosocial stress, particularly due to limited social support, and that CHWs were able to provide some relief in these areas.

We did not detect measurable effects of the CHW-led behavioral program on caregiver or household psychosocial outcomes in urban Chicago families. This could indicate that either the intervention was insufficient to shift intermediate psychosocial targets that CHWs commonly address [16], or that measurement limitations, such as differential item functioning, obscured potential effects. CHWs have been linked to improvements in anxiety and depression, likely through advocacy, coaching, and support navigating healthcare, but the intensity and focus of these activities may determine their effectiveness relative to health education [16, 33-35]. Future research will use a broader range of tools to assess psychosocial domains—including social support, anxiety, depression, trauma, functioning and resilience—in urban caregiver populations. Studies will also examine neighborhood-level factors, including stress and community resilience, to better apply the social-ecological model to oral health behaviors.

Our CHW intervention primarily focused on health knowledge, self-efficacy and education, guided by social cognitive theory and behavioral change principles. In contrast, other CHW programs have placed more emphasis on addressing psychosocial stress or prioritizing social determinants of health over specific disease outcomes [16, 36, 37]. In our intervention, psychosocial stressors were addressed in the context of oral health behaviors. Future interventions should explore whether increasing the emphasis on social determinants of health, with oral health as a secondary focus, could produce more meaningful results. It is also important to distinguish between clinical mental health conditions and the psychosocial stress associated with poverty. While clinical disorders require medical treatment, interventions targeting social determinants involve non-clinical strategies. Our findings of relatively normal psychosocial levels may reflect subclinical stress, and current measures may not fully capture stressors linked to structural racism [38, 39]. Perceptions of stress may be shaped by immediate community context, potentially normalizing psychosocial stress relative to the broader population. Focusing on caregiver functioning may provide a practical approach, as caregivers often balance stressors from poverty and structural inequities with coping strategies that foster resilience. The dynamic interplay between resilience, stress, and functioning may vary across households and over time and could

be critical for supporting sustained oral health behaviors [40-42].

Another limitation was variation in the intervention "dose" received. Although families were offered four CHW visits, participation determined actual exposure, and most families did not complete all visits—consistent with other CHW-led programs [43, 44]. Per-protocol analyses showed that psychosocial outcomes and behaviors did not differ according to the number of visits received. Although four visits were selected based on prior evidence [6], the intensity and frequency may have been insufficient to produce measurable changes. Additionally, the main trial was powered for oral health behavior outcomes, so this secondary analysis may have lacked statistical power.

Despite the absence of measurable effects on household psychosocial factors, this does not indicate failure of CHW interventions. Rather, our findings suggest that future oral health CHW programs should more explicitly address social determinants of health to impact both behavioral and clinical outcomes. This study contributes to a deeper understanding of psychosocial factors—such as anxiety, depression, and stress associated with structural inequities and poverty. Future research will focus on more effective measurement of social determinants of oral health at the household, neighborhood and individual, and levels to guide multi-level interventions aimed at improving health behaviors.

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**Conflict of Interest:** None

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**Ethics Statement:** The studies involving human participants were reviewed and approved by Institutional Review Boards at the University of Illinois at Chicago (2017-1090), the University of California San Francisco (16-19920), and the Chicago Department of Public Health (16-06) approved the trial. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.



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