Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Oral health burden and behavioural determinants of dental caries among Ukrainian civilians attending humanitarian dental missions in 2025 and 2026: a two-wave cross-sectional cohort study in Korosten and Ternopil

En-Tse Yen
Mackay Memorial Hospital
Sung-Hsien Chiu
Mackay Memorial Hospital
Regina Maistrova
Christian Medical Association of Ukraine
Chieh-Yuan Cheng
Mackay Memorial Hospital
Chen-Chain Yen
Matsumoto Dental University
Kun-Zhe Tsai
Mackay Memorial Hospital
Weide Tsai
mmhededucation@gmail.com

Mackay Memorial Hospital

Research Article

Keywords: Ukraine, armed conflict, humanitarian dental mission, oral health, DMFT, dental caries, cross-sectional study, Korosten, Ternopil, health equity

Posted Date: July 9th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9922416/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background.

Recent on-the-ground oral health data from conflict-affected Ukraine are scarce. We characterised the oral health burden and behavioural determinants of caries severity across two humanitarian dental missions (April 2025 and April 2026) at two contrasting sites: geographically exposed Korosten and rear-area Ternopil.

Methods.

Civilians attending MacKay Memorial Hospital mobile clinics underwent a WHO-standardised examination by a single calibrated dentist and completed a Ukrainian-language behavioural questionnaire. The primary outcome was total DMFT; secondary outcomes included any untreated decay, high caries burden (DMFT ≥ 14), Care Index, and Unmet Need. A negative-binomial generalised linear model with robust standard errors and a four-knot restricted cubic spline for age, and logistic regression with stratified bias-corrected and accelerated (BCa) bootstrap (5,000 replicates) for binary outcomes, were fitted. Holm and Benjamini–Hochberg corrections were applied.

Results.

Of 112 civilians examined (2025 n = 46; 2026 n = 66; age 5–81 years; 52.7% male), 93.8% had caries experience; mean DMFT was 10.89 ± 7.40 with the missing component dominating (4.88 ± 5.78). The 2026 cohort was younger and reported twice-daily brushing more often (63.6% vs 43.5%). After adjustment, two predictors were stable across all sensitivity analyses: Korosten versus Ternopil (adjusted IRR 1.32, 95% CI 1.07–1.63, p = 0.009) and twice-daily brushing (IRR 0.73, 0.60–0.89, p = 0.002). Brushing held both Holm- (p = 0.014) and Benjamini–Hochberg- (p = 0.008) adjusted significance; Korosten held Benjamini–Hochberg correction (p = 0.028) but was attenuated under Holm (p = 0.065). Mission wave was not independently associated with DMFT or, after BCa bootstrap, with any untreated decay (adjusted OR 0.43, 0.16–1.19; p = 0.105). Adding ever-smoking did not alter the primary effects.

Conclusions.

Civilians attending humanitarian dental clinics in war-affected Ukraine carry a heavy caries burden dominated by missing teeth. A 32% higher caries burden in geographically exposed Korosten and a 27% reduction with twice-daily brushing both held under sensitivity analysis. Humanitarian dental responses should plan for higher per-patient need at exposed sites and embed brief, standardised oral hygiene support in every encounter.

Background

Armed conflict damages population oral health through several connected pathways: dental supply chains and physical infrastructure are disrupted; displacement breaks the continuity of routine care; household nutrition and hygiene tend to deteriorate; and oral conditions are typically deprioritised when more obviously life-threatening problems are competing for limited clinical time [1,2]. The full-scale Russian invasion of Ukraine that began in February 2022 has produced one of the largest forced-displacement crises Europe has seen since the Second World War, with millions of Ukrainians registered as refugees abroad and several million internally displaced inside the country [3,4].

Within humanitarian response, oral health tends to be sidelined because non-communicable, non-fatal conditions appear less urgent than trauma, infectious disease, or reproductive care. Untreated caries, however, causes pain, sepsis, lost school and work days, and a measurable reduction in quality of life, and these consequences fall most heavily on children, older adults, and people with chronic disease — precisely the groups disadvantaged by conflict [1]. Short-term international missions can partially fill the gap between population need and local service capacity, but their epidemiological contribution depends on standardised data collection across consecutive missions, which most short-term operations do not undertake [5]. Recent data from Ukrainian refugees receiving dental care in neighbouring Poland confirm the scale of the problem: among more than five thousand newly arrived Ukrainian refugees in 2022, dental caries was the single most common diagnosis, affecting around two-thirds of both adults and children [3]. A separate Ukrainian wartime study of internally displaced children inside Ukraine recorded a caries prevalence of approximately 77% in 6–11-year-olds, well above typical age-matched estimates for the country [4]. Similar patterns have been described in other conflict-affected populations, including Libyan children in IDP camps and refugee or IDP children captured in a recent scoping review [6,7].

The MacKay Memorial Hospital (MMH) humanitarian programme has deployed teams of Taiwanese-licensed dentists to Ukraine every year since 2024, in partnership with local authorities and faith-based organisations. Two contrasting mobile-clinic sites have been used throughout: Korosten in Zhytomyr Oblast, a town roughly 100 km west of Kyiv and approximately 80–150 km from the Belarusian border that has been exposed to repeated long-range strikes and now hosts substantial numbers of IDPs from eastern oblasts; and Ternopil in western Ukraine, far from the active ground combat but operating as a major resettlement and transit hub. Together these two sites offer a natural contrast between geographically exposed and rear-area civilian populations within the same country, paralleling the contrast in healthcare access that has been described for transit clinics serving Ukrainians at the Polish and Moldovan borders [8] and for non-dental specialties operating inside Ukraine during the war [9].

Two earlier reports from our group describe the September 2025 deployment in isolation. The first study, a smaller pilot, reported an overall mean DMFT of 12.65 and identified age as the dominant correlate of higher caries burden [10]; the second study, in 230 civilians remaining in war-affected regions, showed a steep age gradient and a shift in the dominant DMFT component from decayed to missing teeth with age [11]. Whether those patterns are stable across a second mission wave, how they compare between

geographically exposed and rear-area sites within the same study, and whether oral hygiene behaviour shifts measurably after one further year of war, are all unanswered.

In the present study we extend the MMH cohort to two consecutive mission waves (April 2025 and April 2026) in Korosten and Ternopil. We ask three questions relevant to humanitarian dental practice. First, what is the current oral health burden among civilians attending humanitarian dental clinics in conflict-affected Ukraine? Second, do oral health indicators and hygiene behaviours differ between the two consecutive waves and between the exposed and rear-area sites? Third, which factors independently predict caries severity once wave, location, age, sex, and behaviour are modelled together?

Methods

Study design and setting

We conducted a cross-sectional cohort study within the framework of the MMH humanitarian programme. Two mission waves were included: April 2025 and April 2026. In each wave, mobile dental clinics ran for two days in Korosten (Zhytomyr Oblast, north-western Ukraine, approximately 100 km west of Kyiv and 80–150 km from the Belarusian border) and two days in Ternopil (western Ukraine, about 130 km east of the Polish border). At the time of both missions, Korosten was subject to repeated long-range missile and unmanned-aerial-vehicle attacks but was not the site of ground combat; Ternopil sits in a rear oblast that has not seen ground combat but hosts large numbers of IDPs. The two-site design was kept identical across both waves to allow within-wave geographic comparison and between-wave temporal comparison.

Participants and recruitment

Eligible participants were all civilians presenting to the mobile clinics during the operating period and consenting to oral examination. Clinics were publicised locally through municipal health offices, host churches, and IDP shelter coordinators. Attendance was open to everyone regardless of age, sex, or insurance status. No financial incentive was offered and no triage was applied at registration. Children younger than 18 years were examined only in the presence of a parent or legal guardian. Participants who declined the structured questionnaire but consented to clinical examination were retained for clinical outcomes and excluded from analyses requiring behavioural data.

Clinical examination

All clinical examinations were performed by a single examiner (E-T.Y.), a Taiwanese-licensed dentist trained in the WHO Oral Health Survey basic methodology [12]. Examinations used portable LED illumination, sterile mouth mirrors, and Community Periodontal Index probes; no radiographs were taken under field conditions. Intra-examiner reliability was assessed by re-evaluating 25 consecutive

participants within a two-week interval during each mission. Cohen's kappa for tooth-level DMFT classification was 0.84 (95% CI 0.78–0.90), and the intraclass correlation coefficient (two-way mixed, absolute agreement) for total DMFT was 0.92. Caries was scored at the tooth level following the WHO Oral Health Surveys Basic Methods, fifth edition [12]. Anterior (incisors and canines) and posterior (premolars and molars) components were recorded separately. Third molars were excluded. Each tooth was classified as decayed (D), missing due to caries (M), or filled (F), and these counts were summed to yield the tooth-level DMFT index, ranging from 0 to 28. The DMFS (surface-level) index was not recorded; under field conditions tooth-level scoring was the only feasible option for a single examiner, and we acknowledge that adding DMFS would permit a more granular assessment. Two derived indices were calculated for participants with any caries experience: Care Index (F / [D + M + F]), the proportion of accumulated caries experience already restored; and Unmet Need (D / [D + M + F]), the proportion currently requiring treatment. Binary outcomes included caries-free status (DMFT = 0), any caries experience (DMFT ≥ 1), any untreated decay (D ≥ 1), and high caries burden (DMFT ≥ 14).

Behavioural and demographic data

The behavioural questionnaire used in this study was the same instrument previously developed and published in our earlier pilot study conducted within this humanitarian dental programme [10]; no items were added or modified for the present study. The questionnaire was translated into Ukrainian by a certified medical translator with independent back-translation into English to verify accuracy, and was administered verbally by trained local interpreters from the Christian Medical Association of Ukraine; corresponding Russian or English versions were used for the small number of participants who preferred those languages. The instrument captured age, self-reported sex, tooth-brushing frequency (categorised as < 2/day, 2/day, ≥ 3/day, and dichotomised as < 2/day vs ≥ 2/day for primary analyses), dental floss use (yes/no), mouth-rinse use (yes/no), current smoking (yes/no), ever smoking (yes/no), and any alcohol use in the past 30 days (yes/no). Participants were also asked about fluoride toothpaste use; uncertainty about the fluoride content of locally available products limited the reliability of this variable, and it was not entered into the multivariable models. A short conflict-exposure module (displacement history, proximity to recent strikes, perceived safety) was piloted in 17 participants at the Korosten site but caused noticeable participant distress during administration and was discontinued after pilot testing; those pilot data were not used. Age was modelled as a continuous covariate using a restricted cubic spline (see below).

Outcomes

The primary outcome was the continuous total DMFT score. Secondary outcomes were the binary indicators above, the Care Index, Unmet Need, and the separate D, M, and F totals.

Statistical analysis

All analyses were performed in Stata 19 for Mac (StataCorp, College Station, TX). Continuous variables are presented as mean ± standard deviation (SD) with range and median (interquartile range, IQR) where appropriate; categorical variables as count and percentage. The full set of pre-specified sensitivity-analysis models is reported in Additional File 1 (Tables S1–S7). The distribution of total DMFT was right-skewed (Additional File 2: Figure S1), so non-parametric tests were used for between-group comparisons of continuous variables. The Mann–Whitney U test compared continuous outcomes between mission waves and between locations; the Hodges–Lehmann median difference is reported alongside the p-value for the primary DMFT contrast. Pearson χ^2 and Fisher's exact tests compared categorical variables. Bias-corrected and accelerated (BCa) 95% confidence intervals for key proportions were obtained from 2,000 stratified bootstrap replicates (strata: wave).

Three multivariable models were specified a priori. (i) A negative-binomial generalised linear model with log link and robust (Huber–White) standard errors was the primary regression for total DMFT. Model family was confirmed by likelihood-based comparison (Poisson AIC 749.8, negative binomial AIC 698.7, zero-inflated negative binomial AIC 680.1); the negative-binomial dispersion parameter α was 0.157 and the Pearson dispersion was 1.09, indicating good fit. Age was entered as a restricted cubic spline with four knots placed at the 5th, 35th, 65th, and 95th percentiles of observed age (11.3, 40.6, 60.0 and 75.4 years) to allow non-linear age effects without assuming a specific functional form. Other covariates were mission wave, location, sex, brushing (< 2/day vs ≥ 2/day), flossing (yes vs no), and mouth-rinse use (yes vs no). Effect sizes are reported as incidence rate ratios (IRR) with 95% Wald CIs. (ii) A binary logistic regression for any untreated decay was fitted with the same covariates; robust standard errors and stratified bootstrap with BCa 95% CIs (5,000 replicates, strata = wave) were obtained, and a Firth bias-reduced penalised logistic regression was fitted as a robustness backup. Model fit was assessed by the Hosmer–Lemeshow test and by the area under the ROC curve. (iii) An ordinary least-squares linear regression for DMFT was fitted as a check on the count model; variance inflation factors confirmed no collinearity (all VIF < 1.2; mean VIF 1.07).

To address multiple comparisons across a pre-specified family of nine primary inferential tests, both Holm-adjusted and Benjamini–Hochberg false-discovery-rate-adjusted p-values were computed. Pre-specified sensitivity analyses were: (i) wave × location interaction added to the primary model; (ii) restriction to participants aged ≥ 12 years; (iii) restriction to adults aged 18–64; (iv) Poisson regression with robust standard errors as a family-of-distribution check; (v) within-wave stratified models; (vi) bootstrap stability check with a second seed; and (vii) addition of ever-smoking to the primary models, since smoking is a recognised periodontal risk factor and was unevenly distributed between waves. Two-sided $p < 0.05$ defined statistical significance throughout.

Ethics

The study protocol was reviewed and approved by the Institutional Review Board of MacKay Memorial Hospital (approval number 25MMHIS074e; valid for three years from the date of issue). Written informed consent was obtained from all adult participants in their preferred language (Ukrainian, Russian, or

English). For participants younger than 18 years, written consent was obtained from a parent or legal guardian, and verbal assent was obtained from the child. All data were de-identified at the point of entry and stored on encrypted devices held by the corresponding author. The study was conducted in accordance with the Declaration of Helsinki and is reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement [13].

Results

Cohort characteristics

A total of 112 civilians completed examination across the two waves: 46 in the 2025 mission (41.1%) and 66 in the 2026 mission (58.9%). Of these, 45 were examined in Korosten (40.2%) and 67 in Ternopil (59.8%). Age ranged from 5 to 81 years (mean 47.95, SD 19.76), and 12 participants (10.7%) were children younger than 18 years. Fifty-nine participants (52.7%) were male. Table 1 summarises demographic and behavioural characteristics by mission wave.

Table 1
Demographic and behavioural characteristics of the study sample, by mission wave (N = 112)

Characteristic	Wave 1 (2025) n = 46	Wave 2 (2026) n = 66	p-value
Demographics			
Age, years, mean (SD)	53.15 (22.61)	44.32 (16.74)	0.005
Age, years, median [IQR]	61.5 [36.0–71.0]	45.0 [32.0–57.0]	—
Male, n (%)	30 (65.2)	29 (43.9)	0.035
Oral hygiene behaviours, n (%)			
Twice-daily toothbrushing	20 (43.5)	42 (63.6)	0.053
Daily flossing	11 (23.9)	20 (30.3)	0.523
Daily mouth-rinse	6 (13.0)	11 (16.7)	0.790
Substance use, n (%)			
Current smoker	1 (2.2)	7 (10.6)	0.138
Ever smoker	1 (2.2)	14 (21.2)	0.004
Alcohol use (past 30 days)	5 (10.9)	6 (9.1)	0.758

Continuous variables compared with Mann–Whitney U test; categorical variables compared with Fisher's exact test. SD, standard deviation; IQR, interquartile range. Twice-daily toothbrushing was self-reported as brushing two or more times per day. Current smoker, smoked within the past 30 days; ever smoker, lifetime tobacco use of any frequency.

The two waves differed in age distribution: participants aged 65 years or older accounted for 45.7% of the 2025 wave but only 10.6% of the 2026 wave (Mann–Whitney p = 0.005; Hodges–Lehmann median age difference 12 years, 95% CI 4–20). Sex distribution also differed, with men comprising 65.2% of the 2025 cohort and 43.9% of the 2026 cohort (Fisher's exact p = 0.035). Twice-daily or more frequent brushing was more common in 2026 (63.6%) than in 2025 (43.5%), although this fell just short of conventional significance (p = 0.053). Daily flossing, mouth-rinse use, current smoking, and alcohol use did not differ significantly between waves; ever-smoking was more common in 2026 (21.2% vs 2.2%, p = 0.004), consistent with the younger profile of that cohort. Korosten and Ternopil were balanced in the 2025 wave (23 and 23 participants, respectively) but Ternopil was over-represented in the 2026 wave (44 vs 22; Fisher's exact p = 0.083). This wave × location imbalance is the principal reason a multivariable model adjusting for both was prespecified.

Oral health burden across the combined cohort

Seven participants (6.3%) were caries-free; 105 (93.8%) had at least one tooth with caries experience. Overall mean DMFT was 10.89 ± 7.40 (range 0–35; median 10, IQR 4–16). The missing component (mean 4.88 ± 5.78) was numerically larger than either the filled (4.74 ± 3.43) or decayed (1.27 ± 2.78) components, consistent with a treatment pathway that has historically favoured extraction over restoration. Posterior DMFT (8.38 ± 5.30) exceeded anterior DMFT (2.52 ± 3.13). Among those with any caries experience (n = 105), the Care Index averaged 0.48 ± 0.31, and Unmet Need averaged 0.16 ± 0.28. Forty-nine participants (43.8%; BCa 95% CI 35.7–54.5%) had at least one tooth requiring restorative treatment, and 34 (30.4%; BCa 95% CI 22.3–38.4%) carried a high caries burden of DMFT ≥ 14.

Caries outcomes by mission wave

Table 2 and Fig. 1A contrast caries outcomes between the two waves. Mean total DMFT was higher in 2025 (13.74 ± 8.25) than in 2026 (8.91 ± 6.06; Mann–Whitney p = 0.001; Hodges–Lehmann median difference 5 teeth, 95% CI 2–8). The difference was driven mainly by the missing component (mean 7.11 vs 3.33, p = 0.042) and by posterior DMFT (10.43 vs 6.94, p < 0.001); the decayed and filled components and anterior DMFT did not differ between waves at p < 0.05. High caries burden (DMFT ≥ 14) was less than half as prevalent in 2026 as in 2025 (18.2% vs 47.8%, p = 0.002), and any untreated decay was less common in 2026 (34.8% vs 56.5%, p = 0.033). Caries-free prevalence rose slightly but non-significantly (7.6% vs 4.3%, p = 0.698). The Care Index and Unmet Need did not differ significantly between waves (p = 0.125 and p = 0.092).

Table 2
Oral health outcomes by mission wave (N = 112)

Outcome	Wave 1 (2025) n = 46	Wave 2 (2026) n = 66	p-value
DMFT and components, mean (SD)			
Total DMFT	13.74 (8.25)	8.91 (6.06)	0.001
Decayed (D)	1.33 (2.22)	1.23 (3.13)	0.077
Missing (M)	7.11 (7.58)	3.33 (3.36)	0.042
Filled (F)	5.30 (3.71)	4.35 (3.19)	0.198
Anterior DMFT	3.30 (4.00)	1.97 (2.23)	0.231
Posterior DMFT	10.43 (5.67)	6.94 (4.54)	< 0.001
Care indices, mean (SD)			
Care Index	0.43 (0.27)	0.52 (0.33)	0.125
Unmet Need	0.19 (0.29)	0.14 (0.27)	0.092
Caries categories, n (%)			
Any decay (D ≥ 1)	26 (56.5)	23 (34.8)	0.033
High caries burden (DMFT ≥ 14)	22 (47.8)	12 (18.2)	0.002
Caries-free (DMFT = 0)	2 (4.3)	5 (7.6)	0.698

Continuous variables compared with Mann–Whitney U test; categorical variables compared with Fisher's exact test. DMFT, Decayed-Missing-Filled Teeth index (WHO 2013 criteria). Anterior teeth: incisors and canines (FDI 13–23, 33–43). Posterior teeth: premolars and molars. Care Index = F / DMFT; Unmet Need = D / DMFT. Both restricted to participants with DMFT > 0 (n = 44 in Wave 1, n = 61 in Wave 2).

Caries outcomes by location

Korosten participants carried a consistently higher caries burden than Ternopil participants (Table 3 and Fig. 1B). Mean DMFT was 13.44 ± 7.92 in Korosten versus 9.18 ± 6.55 in Ternopil (pooled Mann–Whitney $p = 0.004$). The location difference was driven by all three DMFT components, with the largest absolute gap in missing teeth (6.40 vs 3.87, $p = 0.042$). Decayed teeth were also more common in Korosten (mean 2.07 vs 0.73, $p = 0.027$). The Care Index was lower in Korosten (0.40 vs 0.54, $p = 0.021$), consistent with a less treatment-rich oral health trajectory among residents of the exposed area. Within-wave Mann–Whitney tests for total DMFT reached $p < 0.05$ in 2025 but were attenuated in 2026, where the location difference was no longer significant at the bivariate level; multivariable analysis is therefore essential to interpret the geographic effect properly.

Table 3
Oral health outcomes by mission location (N = 112)

Outcome	Korosten n = 45	Ternopil n = 67	p-value
DMFT and components, mean (SD)			
Total DMFT	13.44 (7.92)	9.18 (6.55)	0.004
Decayed (D)	2.07 (3.99)	0.73 (1.30)	0.027
Missing (M)	6.40 (6.50)	3.87 (5.03)	0.042
Filled (F)	4.98 (3.58)	4.58 (3.34)	0.584
Anterior DMFT	3.44 (3.65)	1.90 (2.58)	0.024
Posterior DMFT	10.00 (5.49)	7.28 (4.91)	0.010
Care indices, mean (SD)			
Care Index	0.40 (0.31)	0.54 (0.30)	0.021
Unmet Need	0.22 (0.34)	0.11 (0.21)	0.124

Continuous variables compared with Mann–Whitney U test. DMFT, Decayed-Missing-Filled Teeth index. Korosten (Zhytomyr Oblast) lies approximately 100 km west of Kyiv and 80–150 km from the Belarusian border and was exposed to repeated long-range strikes during the study period. Ternopil (Ternopil Oblast) sits in western Ukraine and hosts large numbers of internally displaced persons but is not directly contested. Care Index = F / DMFT; Unmet Need = D / DMFT. Both restricted to participants with DMFT > 0 (n = 45 in Korosten, n = 60 in Ternopil).

Multivariable model for total DMFT

The primary negative-binomial generalised linear model is presented in Table 4 and Fig. 2. The model fitted well (dispersion α = 0.157; Pearson dispersion 1.09; correlation between predicted and observed DMFT r = 0.74) and was preferred over Poisson regression on AIC and BIC. After adjustment, two predictors emerged as independently associated with caries burden. Korosten residence was associated with a 32% higher expected DMFT relative to Ternopil (adjusted IRR 1.32, 95% CI 1.07–1.63, p = 0.009). Brushing at least twice daily was associated with a 27% lower expected DMFT relative to brushing less than twice daily (adjusted IRR for ≥ 2/day vs < 2/day = 0.73, 95% CI 0.60–0.89, p = 0.002). None of the three restricted-cubic-spline age terms reached significance individually, but the spline taken as a whole captured a clear monotonic gradient with DMFT rising steeply from childhood into the seventh decade and flattening thereafter, as shown by the lowess curves in Additional File 2: Figure S2. Mission wave was not significantly associated with DMFT after adjustment (IRR 0.91 for 2026 vs 2025, 95% CI 0.70–1.19, p = 0.497). Sex, flossing, and mouth-rinse use were not significant predictors.

Table 4
Multivariable negative-binomial regression for total DMFT (N = 112)

Predictor	IRR	95% CI	SE	p-value
Mission wave				
Wave 1 (2025) [reference]	1.00	—	—	—
Wave 2 (2026)	0.91	0.70–1.19	0.121	0.497
Location				
Ternopil [reference]	1.00	—	—	—
Korosten	1.32	1.07–1.63	0.141	0.009
Sex				
Female [reference]	1.00	—	—	—
Male	1.07	0.87–1.31	0.113	0.527
Age (restricted cubic spline, 4 knots)				
Age, term 1	1.02	0.99–1.05	0.015	0.174
Age, term 2	1.01	0.97–1.06	0.025	0.591
Age, term 3	0.92	0.74–1.13	0.098	0.406
Oral hygiene behaviours				
Brushing < 2/day [reference]	1.00	—	—	—
Brushing ≥ 2/day	0.73	0.60–0.89	0.073	0.002
No daily flossing [reference]	1.00	—	—	—
Daily flossing	0.94	0.77–1.14	0.093	0.523
No daily mouth-rinse [reference]	1.00	—	—	—
Daily mouth-rinse	1.13	0.89–1.43	0.139	0.330
Dispersion parameter (α)	0.157	0.079–0.315	—	—

IRR, incidence rate ratio; CI, confidence interval; SE, robust (Huber–White) standard error. Negative-binomial generalised linear model with log link, fitted in Stata 19. Age modelled with a restricted cubic spline (4 knots at the 5th, 35th, 65th, and 95th percentiles: 11.3, 40.6, 60.0 and 75.4 years). Model fit: log-pseudolikelihood = − 338.35; AIC = 698.71; BIC = 728.61; Pearson dispersion = 1.09; correlation between predicted and observed DMFT r = 0.74. Wave × Location interaction tested separately and not retained (IRR 1.08, 95% CI 0.72–1.63, p = 0.700). Across the family of nine primary inferential tests, Holm-adjusted p-values were 0.014 for Brushing ≥ 2/day and 0.065 for Korosten; Benjamini–Hochberg adjusted p-values were 0.008 and 0.028, respectively.

Pre-specified sensitivity analyses supported the same inferences. The wave × location interaction was tested and not retained (IRR for 2026 × Korosten 1.08, 95% CI 0.72–1.63, p = 0.700). Restriction to participants aged ≥ 12 years (n = 107) preserved both the Korosten effect (IRR 1.32, 95% CI 1.06–1.64, p = 0.012) and the brushing effect (IRR 0.72, 95% CI 0.59–0.88, p = 0.001). Restriction to adults aged 18–64 (n = 72) attenuated the Korosten effect to non-significance (IRR 1.18, 95% CI 0.94–1.47, p = 0.158) but retained brushing (IRR 0.76, 95% CI 0.61–0.94, p = 0.011), reflecting the loss of paediatric and elderly participants drawn disproportionately from Korosten. Poisson regression with robust standard errors gave consistent results (Korosten IRR 1.30, p = 0.008; brushing IRR 0.74, p = 0.002). Within-wave stratified models showed the brushing effect was concentrated in the 2026 wave (IRR 0.59, 95% CI 0.43–0.80, p = 0.001) and was non-significant in the smaller 2025 wave (IRR 0.91, p = 0.428). Adding ever-smoking to the model (which differed between waves) did not change the Korosten (IRR 1.32, p = 0.010) or brushing (IRR 0.73, p = 0.001) estimates; ever-smoking itself was not associated with DMFT (IRR 1.01, p = 0.980). After Holm correction across the nine primary inferential tests, the brushing effect on DMFT retained an adjusted p of 0.014, while the Korosten effect was attenuated to borderline (Holm-adjusted p = 0.065). Under the less conservative Benjamini–Hochberg false-discovery-rate procedure, both retained adjusted p-values below 0.05 (brushing p = 0.008; Korosten p = 0.028). We interpret this contrast as expected behaviour given the stringency of familywise versus false-discovery control: the geographic effect holds under FDR control but not under the most conservative multiplicity adjustment, and we report it as stable rather than confirmed beyond doubt.

Multivariable model for any untreated decay

The logistic model for any untreated decay (Table 5; Additional File 2: Figure S4) showed acceptable calibration (Hosmer–Lemeshow $\chi^2 = 8.24$, df = 8, p = 0.410) and modest discrimination (area under the ROC curve 0.73; pseudo $R^2 = 0.135$). No covariate retained statistical significance after robust standard errors and BCa bootstrap correction. The 2026-versus-2025 effect on the odds of any untreated decay had an adjusted OR of 0.43 (95% CI 0.16–1.19, p = 0.105); the BCa bootstrap 95% interval for the wave coefficient crossed the null (–1.99 to 0.51 on the log-odds scale, corresponding to an OR range of approximately 0.14 to 1.66). A bootstrap stability check with a second seed yielded essentially identical intervals (BCa CI for the log-odds − 1.90 to 0.50). Flossing showed a suggestive protective association that fell just short of conventional significance (OR 0.38, 95% CI 0.14–1.03, p = 0.057), as did the first age-spline term (OR 0.90, 95% CI 0.83–0.98, p = 0.012); neither survived multiple-testing correction. Firth bias-reduced logistic regression gave the same picture (wave OR 0.47, p = 0.109; flossing OR 0.42, p = 0.075), confirming that the bootstrap and asymptotic intervals were not driven by small-sample bias. After Holm correction, the wave effect on untreated decay had an adjusted p of 0.165, and the BH-adjusted p was 0.059. We therefore treat the apparent between-wave decline in untreated decay as suggestive but not confirmed by the present sample.

Table 5
Multivariable logistic regression for any decayed teeth (D ≥ 1; N = 112)

Predictor	OR	95% CI	SE	p-value
Mission wave				
Wave 1 (2025) [reference]	1.00	—	—	—
Wave 2 (2026)	0.43	0.16–1.19	0.224	0.105
Location				
Ternopil [reference]	1.00	—	—	—
Korosten	1.84	0.78–4.37	0.811	0.166
Sex				
Female [reference]	1.00	—	—	—
Male	0.85	0.35–2.09	0.391	0.726
Age (restricted cubic spline, 4 knots)				
Age, term 1	0.90	0.83–0.98	0.036	0.012
Age, term 2	1.16	0.98–1.38	0.102	0.085
Age, term 3	0.57	0.25–1.32	0.244	0.188
Oral hygiene behaviours				
Brushing < 2/day [reference]	1.00	—	—	—
Brushing ≥ 2/day	0.95	0.40–2.21	0.410	0.896
No daily flossing [reference]	1.00	—	—	—
Daily flossing	0.38	0.14–1.03	0.193	0.057
No daily mouth-rinse [reference]	1.00	—	—	—
Daily mouth-rinse	0.86	0.22–3.37	0.600	0.834
Intercept	23.98	2.73–210.86	26.60	0.004

OR, odds ratio; CI, confidence interval; SE, robust (Huber–White) standard error. Logistic regression fitted in Stata 19. Outcome: presence of one or more untreated decayed teeth (n = 49/112, 43.8%). Age modelled with a restricted cubic spline (4 knots). Model performance: Hosmer–Lemeshow $\chi^2(8) = 8.24$, $p = 0.410$; area under the ROC curve = 0.73; pseudo $R^2 = 0.135$. Stratified bootstrap with bias-corrected and accelerated (BCa) 95% CIs from 5,000 replicates (4,982 successful) were consistent with the asymptotic CIs shown. Firth bias-reduced logistic regression yielded similar inference (wave OR 0.47, 95% CI 0.19–1.18; flossing OR 0.42, 95% CI 0.16–1.09).

Tables 1–5 are placed at the end of the manuscript, after the References.

Discussion

In this two-wave cohort study of 112 civilians attending humanitarian dental clinics in conflict-affected Ukraine, we documented a substantial caries burden (mean DMFT 10.89, nearly 94% with any caries experience, and 30% carrying DMFT ≥ 14), a stable geographic disadvantage in the exposed Korosten site relative to the rear-area Ternopil site (adjusted IRR 1.32), and a stable independent protective effect of twice-daily brushing (adjusted IRR 0.73). The wave-over-wave decline in mean DMFT was sizeable in absolute terms but is best explained by the younger age profile of the 2026 cohort rather than by a population-level shift; once age was modelled with a flexible spline, mission wave was no longer associated with DMFT, and the apparent decline in untreated decay between waves did not retain significance after adjustment with robust standard errors and BCa bootstrap. These findings carry practical implications for the dental component of the humanitarian response to the war in Ukraine.

Caries burden in international context

Our pooled mean DMFT of 10.89 sits at the higher end of European population estimates. Global Burden of Disease estimates place adult untreated caries among the most prevalent conditions worldwide [14], and oral diseases as a whole remain a major neglected non-communicable disease challenge [1,2]. Among newly arrived Ukrainian refugees in Poland, dental caries was the single most common diagnosis recorded during the first 100 days of the war, affecting around two-thirds of both adults and children [3], which is consistent with a high baseline burden compounded by service disruption. The proportion of the DMFT score accounted for by missing teeth (4.88 of 10.89, about 45%) is high compared with typical Western European values, and the Care Index of 0.48 reflects a treatment environment in which extraction has historically been more accessible than restoration. These features describe a population whose oral health has been shaped by long-standing access barriers; the war has plausibly worsened this configuration rather than created it, an interpretation also supported by our earlier work in the same humanitarian programme [10,11].

Differences between mission waves

The unadjusted decline in mean DMFT between 2025 and 2026 (13.74 to 8.91) was largely attributable to the younger age of the 2026 cohort. Once age was modelled with a flexible spline, mission wave was no longer independently associated with total DMFT. Two points are worth making. First, the younger 2026 cohort probably reflects a real shift in the demographic mix of mission attendees rather than a statistical artefact. In 2025, recruitment was driven by elderly residents and pensioners who had remained in Korosten and Ternopil throughout the war; in 2026, mission visibility had broadened through host-church networks and IDP shelter coordination, reaching working-age adults and parents accompanying children. Second, the apparent wave-related improvement in untreated decay (56.5% in 2025 vs 34.8% in 2026 at the bivariate level) did not retain significance after adjustment for age and behaviour with robust standard errors (adjusted OR 0.43, $p = 0.105$) or after stratified BCa bootstrap (5,000 replicates). Holm-corrected and BH-corrected p-values placed this effect just outside conventional thresholds. We therefore interpret the wave-related decline cautiously and do not claim it

as a population-level effect attributable to the missions themselves. Selection toward individuals with less acute pain, or a younger cohort with shorter time at risk, could plausibly produce the same pattern.

Geographic disparity between Korosten and Ternopil

The most stable geographic finding was the persistent caries disadvantage of Korosten relative to Ternopil after adjustment for individual factors. The adjusted IRR of 1.32 corresponds to roughly a 32% higher expected DMFT for Korosten residents at any given age and behavioural profile, which at the cohort mean age translates into approximately three additional decayed, missing, or filled teeth (estimated marginal mean DMFT 11.27 vs 8.53). The Korosten effect held under age-spline modelling, Poisson and zero-inflated alternatives, restriction to those aged ≥ 12 years, addition of ever-smoking to the model, and false-discovery-rate control (BH-adjusted $p = 0.028$); it was attenuated to borderline under the more conservative familywise Holm procedure (adjusted $p = 0.065$) and lost statistical significance only when paediatric and elderly participants were excluded (adults 18–64 only), consistent with a Korosten catchment that was over-represented at both age extremes. Several plausible pathways link this geographic gradient to oral health: reduced operating hours and staffing at municipal dental clinics in higher-alarm areas, interruption of electrical supply for dental equipment, a higher proportion of IDPs in the Korosten catchment carrying pre-displacement oral health worse than the national average [4,17], and household economic stress pushing routine dental visits aside in favour of acute care only. Our data cannot adjudicate between these mechanisms, but the finding indicates that humanitarian dental responses targeting Ukraine should not assume uniform need across the country, paralleling what has been described for non-dental healthcare provision at the country's borders and within affected oblasts [8,9].

Oral hygiene as a modifiable predictor

Brushing less than twice daily was associated with a 37% higher expected DMFT relative to brushing twice or more daily (equivalently, the IRR for ≥ 2/day vs < 2/day was 0.73). The independence of this effect from mission wave, location, and demographic factors suggests that even in a population whose oral health is shaped by conflict-driven structural forces, individual hygiene behaviour remains an actionable target. The Cochrane evidence on fluoride toothpaste supports the same conclusion at the intervention level: regular brushing with fluoride toothpaste at 1,000–1,500 ppm is the principal non-professional means of caries control [15]. In the logistic model for any untreated decay, flossing showed a suggestive protective association (OR 0.38, $p = 0.057$) that did not reach conventional significance. This result deserves cautious interpretation: flossing prevalence in our sample was low and is likely to correlate with broader health-seeking behaviour, dental literacy, and disposable income. We do not consider flossing as a confirmed independent predictor on the strength of the present data.

The mouth-rinse use prevalence of 15% and the current-smoking prevalence of 7% in our sample are both lower than expected from general-population estimates for Ukraine [16], although a direct comparison is complicated by selection toward older, more health-conscious attendees and possible under-reporting in a context where many participants were elderly women. The non-significant trend

toward higher current smoking in the 2026 wave (10.6% vs 2.2%) and significantly higher ever-smoking (21.2% vs 2.2%) is consistent with the younger cohort. Smoking is a relevant downstream concern for periodontal health that the present design did not measure. As a check on residual confounding from this imbalance, we added ever-smoking to the primary DMFT model and to the logistic model for untreated decay; both Korosten and brushing effects remained essentially unchanged, and ever-smoking itself was not associated with DMFT (IRR 1.01, 95% CI 0.68–1.48) or with any untreated decay (OR 1.34, 95% CI 0.36–5.00).

Implications for humanitarian dental practice

Three operational implications follow. First, oral hygiene education should be embedded in every clinical contact. A brief structured demonstration of twice-daily brushing technique, paired with a take-home toothbrush and fluoride toothpaste kit, is supported both by our adjusted brushing effect and by the underlying evidence base for fluoride toothpaste [15]. Within the time-limited setting of a humanitarian dental clinic, this may yield more public-health benefit than the equivalent time spent on additional restorations. Second, geographic targeting matters. Missions operating in geographically exposed areas should plan for higher per-patient treatment need and, where possible, allocate more chair-time and more advanced restorative materials to those sites. Third, sustained partnership with local Ukrainian dental authorities and academic institutions remains essential to translate short-term mission encounters into durable improvements in population oral health [5]. Inclusion of Ukrainian dental colleagues as co-investigators, examiners, and authors in future iterations of this cohort will strengthen scientific rigour and ensure local ownership of the findings.

Strengths and limitations

Strengths include standardised WHO methodology applied by a single calibrated examiner across both waves and both sites, which removes inter-examiner variability as a source of measurement error; a two-site design contrasting exposed and rear-area Ukrainian populations; the integration of behavioural and clinical data within a single professionally translated and back-translated questionnaire; and the use of a flexible age spline together with robust standard errors, BCa bootstrap, Firth penalised regression, and Holm/BH multiple-testing correction. Partnership with the Christian Medical Association of Ukraine provided all in-country logistics, professional medical translation, and clinical liaison.

Several limitations should be acknowledged. The sample size is modest (n = 112), with correspondingly limited power for the secondary logistic analyses; the wide BCa confidence intervals for the wave and flossing effects on any untreated decay reflect this directly. Recruitment was by convenience, which limits generalisability beyond civilians who chose to attend a free dental clinic. The two waves drew non-overlapping cohorts, so within-person change cannot be estimated. We did not collect periodontal or oral-mucosal outcomes, and caries was scored at the tooth rather than the surface level because of practical constraints under field conditions; future waves should attempt DMFS where feasible. Use of a single examiner, while supporting internal consistency, precludes external inter-examiner comparison; intra-examiner reliability was good ($\kappa = 0.84$) but cannot fully substitute for an independent reference.

Self-reported behavioural variables are subject to social desirability bias, especially when the examiner is also the questioner; future waves will use independent interviewers. We could not verify the fluoride content of the toothpastes that participants actually used, so this variable was excluded from the multivariable models. A short conflict-exposure module piloted in 17 Korosten participants caused noticeable distress during administration and had to be discontinued; consequently, we did not directly measure conflict-specific exposures such as proximity to strike events, duration of displacement, or household disruption that could mediate the location effect we observed. These exposures should be captured by indirect or registry-based methods in subsequent waves to test mechanistic hypotheses about how conflict translates into oral-health disadvantage.

Conclusions

Civilians attending two consecutive humanitarian dental missions in Korosten and Ternopil during 2025 and 2026 carried a substantial caries burden dominated by missing teeth, consistent with a treatment environment that has long favoured extraction over restoration and that has been further stressed by the ongoing armed conflict. Two findings held under multivariable adjustment, sensitivity analyses, and multiple-testing correction: a 32% higher caries burden in the geographically exposed Korosten site relative to rear-area Ternopil at any given age, and a 27% lower caries burden among participants reporting twice-daily brushing. The unadjusted improvement in oral hygiene and untreated decay between waves was attenuated to non-significance once age and behavioural covariates were modelled with appropriate flexibility, and we therefore do not claim a population-level effect of the missions themselves on these outcomes. Recurrent international missions can document and partially mitigate, but cannot alone reverse, the structural oral-health disadvantage produced by conflict. Embedding brief, standardised oral hygiene support in every encounter, allocating additional resources to exposed sites, and sustaining partnership with the Ukrainian dental community will be essential if these data are to translate into durable improvements in population oral health.

Abbreviations

AIC
Akaike Information Criterion
BCa
Bias-corrected and accelerated
BH
Benjamini–Hochberg
BIC
Bayesian Information Criterion
CI
Confidence interval
CMA-Ukraine
Christian Medical Association of Ukraine

CPI
Community Periodontal Index
D
Decayed (tooth)
DMFT
Decayed, Missing, and Filled Teeth index
F
Filled (tooth)
FDR
False discovery rate
GBD
Global Burden of Disease
GLM
Generalised linear model
IDP
Internally displaced person
IQR
Interquartile range
IRB
Institutional Review Board
IRR
Incidence rate ratio
M
Missing (tooth)
MMH
MacKay Memorial Hospital
OR
Odds ratio
RCS
Restricted cubic spline
ROC
Receiver operating characteristic
SD
Standard deviation
STROBE
Strengthening the Reporting of Observational Studies in Epidemiology
VIF
Variance inflation factor
WHO
World Health Organization

Declarations

Ethics approval and consent to participate

The study protocol was reviewed and approved by the Institutional Review Board of MacKay Memorial Hospital, Taipei, Taiwan (approval number 25MMHIS074e; valid for three years from the date of issue). Written informed consent was obtained from all adult participants in their preferred language (Ukrainian, Russian, or English). For participants younger than 18 years, written consent was obtained from a parent or legal guardian and verbal assent was obtained from the child. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Consent for publication

Not applicable. The manuscript does not contain any individually identifiable data, images, or videos.

Availability of data and materials

The datasets generated and analysed during the current study are not publicly available owing to institutional review board restrictions and the data-protection regulations of Taiwan and Ukraine, but the de-identified data are available from the corresponding author on reasonable request. The Stata 19 analysis syntax used in this study is also available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

The humanitarian missions were supported by the MacKay Memorial Hospital International Medical Mission Fund and by private donations channelled through the Taiwan–Ukraine humanitarian fellowship. No external commercial funding was received. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Authors' contributions

E-TY and S-HC drafted the manuscript and share first authorship. E-TY also designed the clinical record and served as the sole clinical examiner during both mission waves. S-HC contributed to manuscript drafting. RM, the in-country medical lead from CMA-Ukraine, coordinated all field logistics across both mission waves and oversaw the professional medical translation and back-translation of the Ukrainian-language questionnaire as well as all clinician–patient communication. C-YC contributed to project and resource management. C-CY, based at Matsumoto Dental University, performed the formal statistical analysis in Stata 19. K-ZT contributed to the final statistical analysis and to manuscript drafting. W-DT contributed to project and resource management, supervised the overall project, served as

corresponding author, and revised the final manuscript. All authors read and approved the final version of the manuscript.

Acknowledgements

We acknowledge the invaluable help from the Christian Medical Association of Ukraine and from the Ukrainian people, who continue to live with daily air raids. We thank CMA-Ukraine for its sustained partnership across both mission waves and for providing all in-country logistics, professional medical translation, and clinical liaison. We also thank the municipal health authorities of Korosten and Ternopil, the host churches and IDP coordination centres in both cities, the volunteer interpreters who supported trilingual questionnaire administration, and all participants who entrusted us with their oral health during this difficult period. We acknowledge the Taiwan Foundation for Disaster Relief and the MacKay Memorial Hospital International Medical Mission office for logistical support. We dedicate this work to the dental colleagues of Ukraine who have continued to provide care to their communities under extraordinarily difficult conditions.

Authors' information

E-TY is an attending physician in the Department of Orthodontics, MacKay Memorial Hospital, and a core member of the MMH international humanitarian medical mission programme. W-DT is an attending physician at MacKay Memorial Hospital and director of the MMH international humanitarian medical mission programme.

References

1. Peres MA, Macpherson LMD, Weyant RJ, Daly B, Venturelli R, Mathur MR, et al. Oral diseases: a global public health challenge. Lancet. 2019;394(10194):249–60. doi:10.1016/S0140-6736(19)31146-8.
2. Pitts NB, Twetman S, Fisher J, Marsh PD. Understanding dental caries as a non-communicable disease. Br Dent J. 2021;231(12):749–53. doi:10.1038/s41415-021-3775-4.
3. Lewtak K, Chowaniec-Prażuch A, Rhone I, Klukowska A, Kucherenko I, Chehertma E, et al. Oral health needs and oral healthcare utilization among newly arrived Ukrainian refugees in Poland: a retrospective EHR-based study. BMC Oral Health. 2026;26(1):269. doi:10.1186/s12903-026-07672-5.
4. Sheshukova OV, Mosiienko AS, Polishchuk TV, Trufanova VP, Bauman SS, Kazakova KS, et al. Epidemiology of dental caries in internally displaced children during wartime in Ukraine. Wiad Lek. 2024;77(6):1155–60. doi:10.36740/WLek202406107.
5. Caldron PH, Impens A, Pavlova M, Groot W. A systematic review of social, economic and diplomatic aspects of short-term medical missions. BMC Health Serv Res. 2015;15:380. doi:10.1186/s12913-015-0980-3.
6. Folayan MO, Schroth RJ, Ayouni I, Nguweneza A, Arheiam A, Al-Batayneh OB, et al. A scoping review linking early childhood caries to violence, neglect, internally displaced, migrant and refugee status.

BMC Oral Health. 2023;23(1):747. doi:10.1186/s12903-023-03459-0.

7. Arheiam A, Alhashani A, Kwidir T, Bosif Y, Ballo L, El Tantawi M. Untreated dental caries among Libyan children during and after the war and in internally displaced person camps. Community Dent Oral Epidemiol. 2023;51(4):636–43. doi:10.1111/cdoe.12886.
8. Aljadeeah S, Hosseinalipour SM, Khanyk N, Szocs E, Traianou A, Tomas A, et al. Healthcare provision for displaced people in transit: analyses of routinely collected data from INTERSOS clinics at the Ukrainian border with Moldova and Poland. J Migr Health. 2025;11:100287. doi:10.1016/j.jmh.2024.100287.
9. Flomin Y, Dubenko A, Dubenko O, Sokolova L, Slobodin T, Shepotinnyk Y, et al. Neurological practice in the time of war: perspectives and experiences from Ukraine. Semin Neurol. 2024;44(2):225–32. doi:10.1055/s-0044-1782515.
10. Yen E-T, Chiu S-H, Tsai W, Chang WH, Lai T-T. Oral health status in conflict-affected regions of Ukraine: a cross-sectional pilot study during a humanitarian dental mission. BMC Oral Health. 2026;26(1):428. doi:10.1186/s12903-026-07764-2.
11. Yen E-T, Chiu S-H, Tsai W-D, Lin G-M, Tsai K-Z. Dental caries prevalence and age-related patterns among populations remaining in war-affected regions of Ukraine. J Dent Sci. 2026;21(1):620–3. doi:10.1016/j.jds.2025.11.001.
12. World Health Organization. Oral Health Surveys: Basic Methods. 5th ed. Geneva: WHO; 2013. https://www.who.int/publications/i/item/9789241548649. Accessed 21 May 2026.
13. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet. 2007;370(9596):1453–7. doi:10.1016/S0140-6736(07)61602-X.
14. GBD 2017 Oral Disorders Collaborators; Bernabe E, Marcenes W, Hernandez CR, Bailey J, Abreu LG, et al. Global, regional, and national levels and trends in burden of oral conditions from 1990 to 2017: a systematic analysis for the Global Burden of Disease 2017 Study. J Dent Res. 2020;99(4):362–73. doi:10.1177/0022034520908533.
15. Walsh T, Worthington HV, Glenny AM, Marinho VCC, Jeroncic A. Fluoride toothpastes of different concentrations for preventing dental caries. Cochrane Database Syst Rev. 2019;3(3):CD007868. doi:10.1002/14651858.CD007868.pub3.
16. Skipalskyi A, Habicht J, Ciobanu A, Tarasenko Y, Skapa T. Tobacco control in complex emergencies: policy case study of Ukraine. Tob Prev Cessat. 2025;11:25. doi:10.18332/tpc/203838.
17. United Nations High Commissioner for Refugees. Ukraine refugee situation: regional overview. Geneva: UNHCR; 2025. https://data.unhcr.org/en/situations/ukraine. Accessed 18 May 2026.

Figures

Figure 1. DMFT components

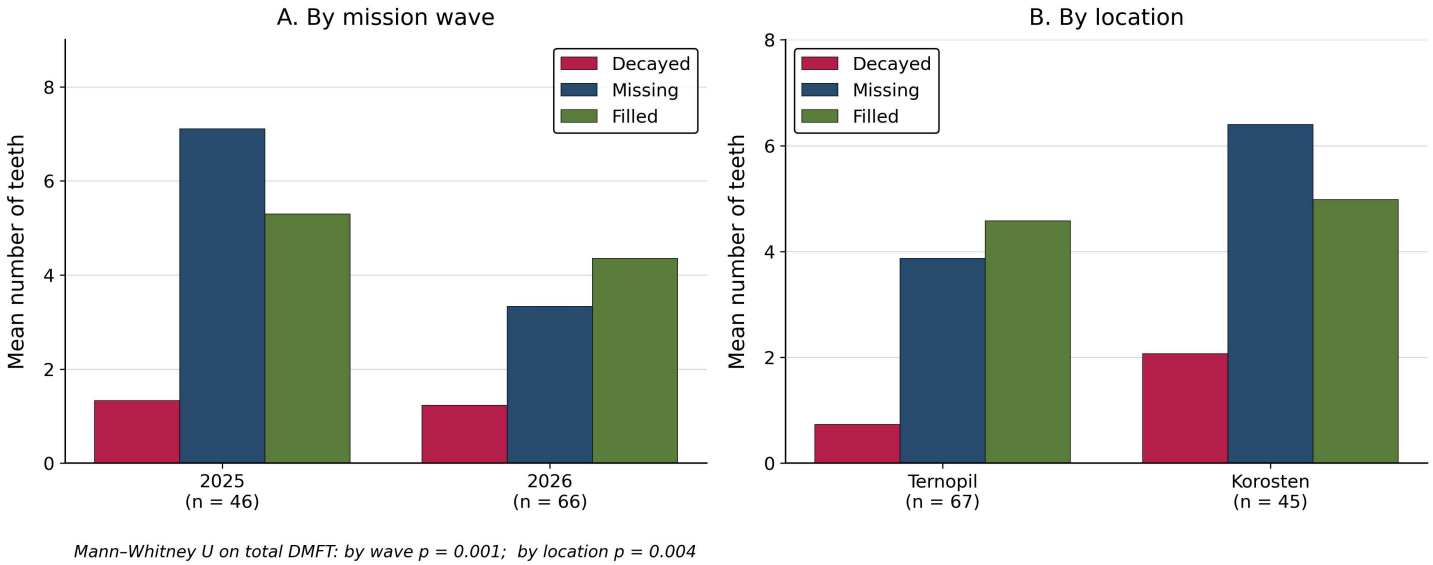


Figure 1

DMFT components by mission wave and by location. Panel A shows mean Decayed (D), Missing (M), and Filled (F) tooth counts in the 2025 (n = 46) and 2026 (n = 66) waves; Mann–Whitney U test on total DMFT p = 0.001. Panel B shows mean D, M, and F components in Korosten (n = 45) and Ternopil (n = 67), pooled across both waves; Mann–Whitney U test on total DMFT p = 0.004.

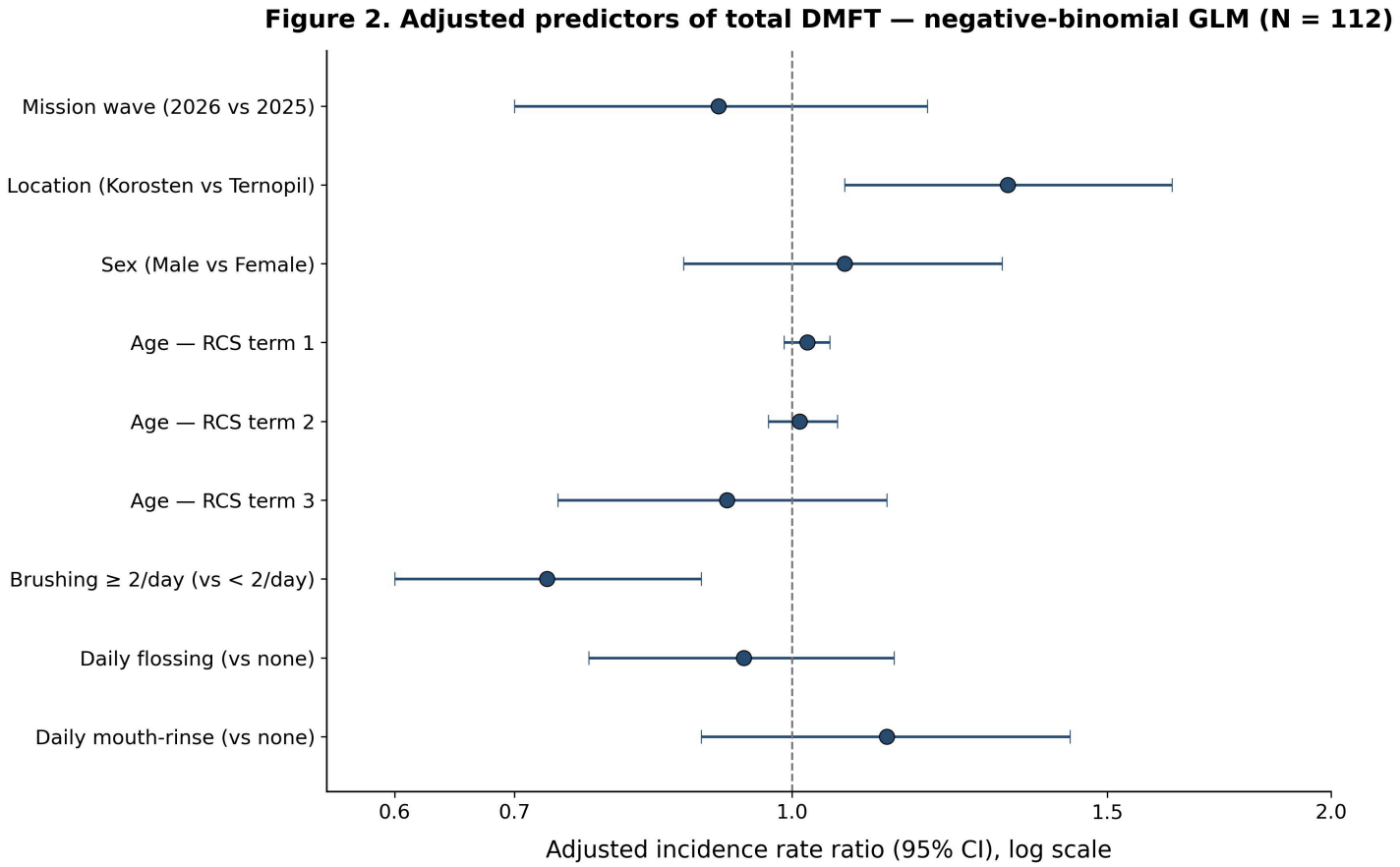


Figure 2

Forest plot of adjusted incidence rate ratios (IRR) and 95% confidence intervals from the multivariable negative-binomial generalised linear model for total DMFT (N = 112), corresponding to Table 4. The dashed vertical line indicates an IRR of 1.0 (no association). Age is shown as the three restricted-cubic-spline (RCS) basis terms produced by four knots placed at the 5th, 35th, 65th, and 95th percentiles (11.3, 40.6, 60.0 and 75.4 years); these three terms jointly capture the age gradient even though no single spline coefficient reaches conventional significance, as shown in Additional File 2: Figure S2. Reference categories: 2025 mission wave, Ternopil, Female sex, Brushing < 2/day, No daily flossing, and No daily mouth-rinse use.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- AdditionalFile1SupplementaryTables.docx
- AdditionalFile2SupplementaryFigures.docx