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INTERDENTAL CLEANING AIDS ARE BENEFICIAL FOR ORAL HEALTH AT FOLLOW-UP

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SHIP-TREND was approved by the ethics committee. All study participants provided written informed consent to participate in the study.

AIM

We estimated associations of interdental cleaning aids (IDA) use and type on 7-year follow-up levels of interdental plaque, interdental gingival inflammation, interdental periodontitis severity, the number of interdental sound surfaces and the number of missing teeth in a population-based cohort study.

MATERIALS AND METHODS

We used 7-year follow-up data of 2224 Study of Health in Pomerania (SHIP-TREND) participants. We applied generalized linear and ordinal logistic models, adjusting for confounding and selection bias using inverse probability treatment weighting and multiple imputation.

RESULTS

Flossers were 0.68 less likely to have higher interdental plaque levels than non-users of IDA (OR=0.68; 95%CI: 0.50-0.94); flossing resulted in 5% lower means of iPlaque. Effects on interdental bleeding on probing (iBOP), mean interdental probing depths, and mean interdental clinical attachment levels were direction-consistent, but statistically non-significant. Interdental brushing was associated with lower follow-up levels for interdental plaque (OR=0.73; 95%CI: 0.57-0.93) and iBOP (OR=0.69; 95%CI: 0.53-0.89). IDAs were more effective in reducing iPlaque in periodontitis cases, while iBOP reduction was more pronounced in non-periodontitis cases. The analyses did not suggest that the use of IDAs affected caries. Finally, applying change score analyses, flossing reduced tooth loss incidence (IRR=0.71) compared to IDA non-users.

Table 1. Baseline characteristics (SHIP-TREND-0) for participants present in the final model for the number of missing teeth in total and stratified by interdental cleaning aids usage and type.

	IDA non-user	Wooden stick user	Dental flosser	Interdental brusher	P value †
N	1,576	156	230	262	
Age, years	47 (37; 58)	57 (47; 64)	47 (37; 56)	56 (45; 64)	<0.001
Male sex, yes	833 (52.9%)	83 (53.2%)	72 (31.3%)	95 (36.3%)	<0.001
School education					
<10 years	186 (11.8%)	26 (16.7%)	16 (7.0%)	43 (16.4%)	
10 years	880 (55.8%)	90 (57.7%)	126 (54.8%)	142 (54.2%)	
>10 years	510 (32.4%)	40 (25.6%)	88 (38.3%)	77 (29.4%)	0.008
Household equivalence income, € ‡	1450 (1096; 1803)	1184 (836; 1761)	1450 (1096; 2050)	1450 (1096; 1803)	0.0055
Smoking status					
Never smoker	585 (37.1%)	60 (38.5%)	92 (40.0%)	114 (43.5%)	
Former smoker	600 (38.1%)	61 (39.1%)	90 (39.1%)	111 (42.4%)	
Current smoker	391 (24.8%)	35 (22.4%)	48 (20.9%)	37 (14.1%)	0.017
Brushing ≥2 times/day, yes	1,338 (84.9%)	133 (85.3%)	215 (93.5%)	249 (95.0%)	<0.001
Toothbrush usage					
Manual toothbrush	1,135 (72.0%)	113 (72.4%)	148 (64.4%)	169 (64.5%)	
Powered toothbrush	435 (27.6%)	41 (26.3%)	82 (35.6%)	91 (34.7%)	
None	6 (0.4%)	2 (1.3%)	0 (0%)	2 (0.8%)	0.019
Dental visit within last 12 months, yes	1,426 (90.5%)	138 (88.5%)	220 (95.7%)	258 (98.5%)	<0.001
Gum treatment within last 5 years, yes	278 (17.6%)	33 (21.2%)	50 (21.7%)	94 (35.9%)	<0.001
Known diabetes mellitus, yes	86 (5.5%)	16 (10.3%)	4 (1.7%)	18 (6.9%)	0.003
Haemoglobin A1c, %	5.2 (4.8; 5.5)	5.3 (4.9; 5.6)	5.1 (4.8; 5.4)	5.3 (4.9; 5.6)	0.0046
Body Mass Index, kg/m²	27.1 (24.2; 30.1)	27.8 (25.8; 31.6)	25.7 (23.4; 28.8%)	26.9 (23.9; 29.7)	<0.001
Physical activity, yes	1,100 (69.8%)	110 (70.5%)	188 (81.7%)	205 (78.2%)	<0.001
Last time consulting a doctor (except for a dentist)?					
Within the last 4 weeks	597 (37.9%)	63 (40.4%)	92 (40.0%)	97 (37.0%)	
Within the last 2-12 months	775 (49.2%)	80 (51.3%)	105 (45.7%)	149 (56.9%)	
More than a year ago	204 (12.9%)	13 (8.3%)	33 (14.3%)	16 (6.1%)	0.015
Participation in cancer screening, yes	922 (58.5%)	114 (73.1%)	161 (70.0%)	205 (78.2%)	<0.001

Data are presented as median (25%; 75% quantiles) or as number (percentage). † Kruskal Wallis test or Chi squared test, testing for distributional differences across all four groups; Abbreviations: IDA, interdental cleaning aids.

Table 2. Confounder-adjusted associations between different types of interdental cleaning aids users with non-users of interdental cleaning aids (reference) and oral health variables in ANCOVA and change score models using complete case data of the Study of Health in Pomerania. Confounder-adjustment using inverse probability treatment weighting.

		IDA non-user	Wooden stick user		Dental flosser		Interdental brusher	
Outcome variable	N	OR, β or IRR	OR, β or IRR (95% CI)	P value	OR, β or IRR (95% CI)	P value	OR, β or IRR (95% CI)	P value
Including all participants with self-reported information on IDA use and type at baseline								
ANCOVA								
iPlaque, %	2121	1.00 (ref.)	1.78 (1.38; 2.30)	<0.0001	0.68 (0.50; 0.94)	0.018	0.73 (0.57; 0.93)	0.010
iBOP, %	2086	1.00 (ref.)	1.51 (1.06; 2.15)	0.024	0.79 (0.56; 1.12)	0.183	0.69 (0.53; 0.89)	0.005
Mean iPD, mm	2089	1.00 (ref.)	1.10 (0.77; 1.55)	0.608	0.78 (0.54; 1.11)	0.163	0.81 (0.60; 1.10)	0.173
% sites with iPD ≥4 mm, %	2089	1.00 (ref.)	1.33 (0.96; 1.84)	0.085	0.81 (0.56; 1.17)	0.258	1.04 (0.79; 1.37)	0.761
Mean iCAL, mm	1986	1.00 (ref.)	0.96 (0.58; 1.58)	0.869	0.77 (0.54; 1.11)	0.166	1.27 (0.94; 1.70)	0.117
CDC/AAP case definition	1953	1.00 (ref.)	1.53 (1.06; 2.21)	0.024	0.85 (0.56; 1.28)	0.431	1.21 (0.87; 1.69)	0.266
Number of interdental sound surfaces	2143	0.00 (ref.)	-1.15 (-2.43; 0.13)	0.079	0.41 (-0.65; 1.46)	0.450	-0.48 (-1.51; 0.55)	0.360
Number of missing teeth	2224	1.00 (ref.)	1.37 (0.99; 1.89)	0.054	0.99 (0.75; 1.31)	0.954	1.28 (0.99; 1.66)	0.064
Change score analysis								
Tooth loss	2224	1.00 (ref.)	1.45 (1.29; 1.63)	<0.001	0.71 (0.63; 0.79)	<0.001	1.44 (1.31; 1.59)	<0.001
Including only participants with identical self-reported information on IDA use and type at baseline and 7-year follow-up								
ANCOVA								
iPlaque, %	1370	1.00 (ref.)	1.02 (0.56; 1.85)	0.941	0.64 (0.40; 1.03)	0.068	0.54 (0.37; 0.77)	0.001
iBOP, %	1352	1.00 (ref.)	1.04 (0.62; 1.75)	0.894	0.62 (0.40; 0.96)	0.033	0.59 (0.41; 0.85)	0.005
Mean iPD, mm	1355	1.00 (ref.)	1.76 (0.98; 3.15)	0.058	0.64 (0.36; 1.12)	0.120	0.71 (0.46; 1.08)	0.112
% sites with iPD ≥4 mm, %	1355	1.00 (ref.)	1.79 (0.98; 3.29)	0.059	0.58 (0.31; 1.10)	0.096	0.91 (0.62; 1.32)	0.608
Mean iCAL, mm	1286	1.00 (ref.)	1.46 (0.47; 4.51)	0.516	0.70 (0.39; 1.24)	0.222	1.13 (0.75; 1.70)	0.553
CDC/AAP case definition	1262	1.00 (ref.)	1.61 (0.65; 3.98)	0.299	0.78 (0.37; 1.68)	0.531	1.08 (0.72; 1.60)	0.717
Number of interdental sound surfaces	1388	0.00 (ref.)	-0.11 (-0.72; 0.50)	0.719	0.46 (0.08; 0.84)	0.018	-0.23 (-0.54; 0.07)	0.139
Number of missing teeth	1398	1.00 (ref.)	1.08 (0.55; 2.11)	0.833	0.96 (0.62; 1.49)	0.867	1.26 (0.88; 1.80)	0.206
Change score analysis								
Tooth loss	1398	1.00 (ref.)	0.54 (0.28; 1.07)	0.059	0.56 (0.36; 0.88)	0.011	0.98 (0.73; 1.33)	0.885

Models: iPlaque, iBOP, % sites with iPD ≥4 mm, mean iPD, mean iCAL, CDC/AAP case definition, number of missing teeth: ordinal logistic model; number of interdental sound surfaces: linear model; tooth loss: negative binomial model. Adjusted for baseline values of the outcome (except for change score analysis), age, sex, education, household equivalence income, smoking, body mass index, known diabetes mellitus, hemoglobin A1c, toothbrushing frequency, dental visits in the last 12 months, and powered tooth brush usage; models for periodontal variables were additionally adjusted for physical activity and gum treatment within the last 5 years. Abbreviations: AAP, American Academy of Periodontology; β, beta regression coefficient; CDC, Centers for Disease Control and Prevention; CI, confidence interval; iBOP, percentage of interdental sites with bleeding on probing; iCAL, interdental clinical attachment level; iPD; interdental probing depth; iPlaque, percentage of interdental sites with plaque; IRR, Incidence Rate Ratio; N, number; OR, Odds Ratio.

Table 3. Effect moderation (EM) by baseline CDC/AAP case definition status (no/mild versus moderate/severe periodontitis): Predicted means of oral health variables for combinations of the CDC/AAP case definition with interdental cleaning aids use and type using complete case data of the Study of Health in Pomerania. Confounder-adjustment using inverse probability treatment weighting performed within strata of the effect moderator.

Outcome variable	N obs.	CDC/AAP category	IDA non-user	Wooden stick user	Dental floss user	Interdental brush user	P for EM
iPlaque, %	1038	No/mild	19.7 (17.8; 21.5)	24.1 (17.0; 31.3)	13.3 (9.8; 16.7) [a]	14.7 (10.0; 19.4) [a]	
	983	Moderate/severe	33.2 (31.0; 35.3)	37.1 (31.7; 42.4)	21.6 (16.4; 26.8) [a]	23.8 (20.0; 27.6) [a]	0.910
iBOP, %	1031	No/mild	20.2 (18.6; 21.9)	22.7 (16.9; 28.4)	17.2 (13.7; 20.7)	10.0 (6.7; 13.3) [a]	
	966	Moderate/severe	24.0 (22.3; 25.8)	24.2 (20.0; 28.5)	18.7 (14.4; 23.0)	21.6 (18.3; 24.9)	0.196
Mean iPD, mm	1030	No/mild	2.54 (2.50; 2.58)	2.62 (2.48; 2.76)	2.43 (2.35;2.52) [a]	2.42 (2.31; 2.52) [a]	
	967	Moderate/severe	2.95 (2.90; 2.99)	2.84 (2.72; 2.96)	2.82 (2.70; 2.95)	2.82 (2.73; 2.91) [a]	0.340
% sites with iPD ≥4 mm, %	1030	No/mild	7.3 (6.3; 8.3)	10.3 (6.3; 14.5)	5.8 (3.8; 7.9)	6.6 (3.9; 9.3)	
	967	Moderate/severe	22.9 (21.2; 24.7)	21.1 (16.9; 25.4)	17.5 (13.3; 21.8)	19.1 (15.8; 22.3)	0.438
Mean iCAL, mm	1023	No/mild	1.82 (1.76; 1.87)	1.79 (1.58; 1.99)	1.69 (1.58; 1.81) [a]	1.75 (1.59; 1.91)	
	948	Moderate/severe	2.75 (2.67; 2.84)	2.72 (2.48; 2.95)	2.58 (2.34; 2.81)	2.82 (2.64; 3.00)	0.826

Models: iPlaque, iBOP, % sites with iPD ≥4 mm: Fractional response model; Mean iPD, mean iCAL: GLM with gamma distribution and log link. Adjusted for baseline values of the outcome, age, sex, education, household equivalence income, smoking, body mass index, known diabetes mellitus, hemoglobin A1c, toothbrushing frequency, dental visits in the last 12 months, and powered tooth brush usage; models for periodontal variables were additionally adjusted for physical activity and gum treatment within the last 5 years. Abbreviations: AAP, American Academy of Periodontology; β, beta regression coefficient; CDC, Centers for Disease Control and Prevention; CI, confidence interval; iBOP, percentage of interdental sites with bleeding on probing; iCAL, interdental clinical attachment level; iPD; interdental probing depth; iPlaque, percentage of interdental sites with plaque; IRR, Incidence Rate Ratio; N, number; OR, Odds Ratio. [a] P<0.05 for average marginal effects versus IDA non-users.

CONCLUSIONS

Recommending flossing and interdental brushing in dental practices could represent an approach to the prevention of gingivitis and consequently periodontitis.