

## Trends in periodontal status: results from the German Oral Health Studies from 2005 to 2023 – Online Appendix

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### ABSTRACT

**Objectives:** The objective of this study was twofold: firstly, to provide an overview of trends in periodontal status among younger adults aged 35 to 44 years and younger seniors aged 65 to 74 years between 2005 and 2023, based on data from the German Oral Health Studies (DMS); secondly, to quantify the extent to which observed differences in tooth count variables between consecutive studies can be attributed to differences in characteristics.

**Method and materials:** The data from DMS IV (2005), DMS V (2014), and DMS • 6 (2023) were analyzed. The participants completed questionnaires concerning their oral health behaviors, and general and oral health. For this analysis, probing depths (PD) were calculated from three sites on 12 index teeth as a common denominator. The number of teeth, severity, and extent of PD and the Community Periodontal Index (CPI) were reported. Multivariate decomposition was employed to analyze differences by time.

**Results:** The proportion of edentate younger seniors notably declined, from 23.2% to 5.4%, between 2005 and 2023. Similarly, the mean number of teeth for dentate younger seniors was 2.4 teeth higher in DMS • 6. While the mean PD remained 2.4 mm for younger adults and 2.8 mm for younger seniors, inconsistent patterns were observed for extent variables. In most cases, a decline of the extent variables was observed between DMS IV and DMS V, with a rebound at DMS • 6 for severe cases in younger seniors (with PD  $\geq$  6 mm). The proportion of younger adults and seniors with CPI scores of 0 to 2 increased considerably between DMS IV and DMS V, but rebounded at DMS • 6. Overall, the prevalence of these cases increased by approximately 10% points and 5% points, respectively. The majority of the observed reduction in the number of missing teeth (in younger adults) or the prevalence of having less than 20 teeth (in younger seniors) between DMS IV and DMS V and between DMS V and DMS • 6 were explained by an increase in the proportion of highly educated individuals, an increase in the proportion of those who have never smoked (only younger adults), an increase in the proportion of individuals using electric toothbrushes or interdental cleaning devices, and a reduction in the proportion of individuals with lifetime periodontal treatment.

**Conclusion:** Over the last two decades, there has been a significant improvement in periodontal health in Germany, with the most notable enhancements occurring between DMS IV and DMS V. The prevalence of periodontal disease has decreased significantly in recent decades, largely due to the implementation of preventive measures. This underscores the importance of integrating preventive measures into dental practice as a public health strategy.

**KEYWORDS:** dental care, dentists, DMS 6, multivariate decomposition, number of missing teeth, periodontitis, trend analysis

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## Appendix 1

**Table A1.1: Detailed results from multivariate decomposition models for dentate younger adults (35- to 44-year-olds; dependent variable: “number of missing teeth”; Poisson models)**

		Decomposition for “Number of missing teeth”			
		DMS IV to DMS V (n=1822)		DMS V to DMS • 6 (n=1759)	
		Coefficient (95% CI)	Percentage	Coefficient (95% CI)	Percentage
Difference		-0.786 (-0.922; -0.651)		-0.510 (-0.625; -0.395)	
Due to difference in characteristics		-0.221 (-0.270; -0.171)	28.1%	-0.159 (-0.204; -0.114)	31.2%
Due to difference in coefficients		-0.566 (-0.716; -0.415)	71.9%	-0.351 (-0.480; -0.222)	68.8%
		<b>Model for differences in characteristics</b>		<b>Model for differences in characteristics</b>	
		<b>Coefficient (95% CI)</b>	<b>P value</b>	<b>Coefficient (95% CI)</b>	<b>P value</b>
Age, years	-	0.088 (0.060; 0.116)	<0.001	0.018 (0.011; 0.256)	<0.001
Gender (ref. female)	Male	-0.024 (-0.031; -0.018)	<0.001	-0.010 (-0.015; -0.005)	<0.001
School education (ref. <10 years)	10 years	0.020 (0.006; 0.033)	0.004	0.045 (0.019; 0.070)	0.001
	>10 years	-0.140 (-0.170; -0.109)	<0.001	-0.118 (-0.164; -0.072)	<0.001
Smoking status (ref. current smokers)	Former smokers	-0.030 (-0.044; -0.017)	<0.001	0.045 (0.031; 0.058)	<0.001
	Never smoked	-0.016 (-0.021; -0.010)	<0.001	-0.069 (-0.085; -0.054)	<0.001
Body Mass Index, kg/m <sup>2</sup>	-	0.009 (0.002; 0.016)	0.008	0.001 (-0.003; 0.005)	0.779
Diabetes mellitus (ref. no)	Yes	NA	NA	0.001 (-0.001; 0.003)	0.165
Tooth brushing frequency (ref. ≥2 times daily)	<2 times daily	-0.003 (-0.009; 0.002)	0.256	0.0002 (-0.001; 0.001)	0.543
Electric toothbrush utilization (ref. no)	Yes	-0.035 (-0.055; -0.014)	0.001	-0.023 (-0.037; -0.008)	0.002
Interdental cleaning aids utilization (ref. no)	Yes	-0.035 (-0.050; -0.020)	<0.001	-0.022 (-0.031; -0.013)	<0.001
Dental visits frequency (ref. rarely)	≥ once a year	-0.009 (-0.020; 0.001)	0.088	-0.0004 (-0.001; -0.0001)	0.023
Lifetime periodontal treatment (ref. no)	Yes	-0.045 (-0.056; -0.034)	<0.001	-0.026 (-0.042; -0.011)	0.001

NA, not available.

**Table A1.2: Detailed results from multivariate decomposition models for dentate younger seniors (65- to 74-year-olds; dependent variable: “having less than 20 teeth”; coded as yes/no; logistic models)**

		Decomposition for “Having less than 20 teeth”			
		DMS IV to DMS V (n=1562)		DMS V to DMS • 6 (n=1459)	
		Coefficient (95% CI)	Percentage	Coefficient (95% CI)	Percentage
Difference		-0.109 (-0.156; -0.063)		-0.076 (-0.121; -0.031)	
Due to difference in characteristics		-0.029 (-0.049; -0.008)	26.2%	-0.051 (-0.075; -0.028)	67.6%
Due to difference in coefficients		-0.081 (-0.132; -0.030)	73.8%	-0.025 (-0.078; 0.029)	32.4%
		Model for differences in characteristics		Model for differences in characteristics	
		Coefficient (95% CI)	P value	Coefficient (95% CI)	P value
Age, years	-	0.008 (0.00003; 0.015)	0.049	0.004 (-0.0003; 0.009)	0.065
Gender (ref. female)	Male	0.001 (0.0002; 0.002)	0.012	0.001 (0.00004; 0.002)	0.039
School education (ref. <10 years)	10 years	-0.008 (-0.015; -0.001)	0.023	0.001 (-0.007; 0.008)	0.837
	>10 years	-0.007 (-0.014; -0.0003)	0.041	-0.014 (-0.024; -0.003)	0.012
Smoking status (ref. current smokers)	Former smokers	-0.004 (-0.007; -0.0004)	0.026	-0.004 (-0.008; 0.001)	0.104
	Never smoked	0.012 (0.005; 0.019)	<0.001	0.008 (0.002; 0.013)	0.005
Body Mass Index, kg/m <sup>2</sup>	-	-0.0003 (-0.002; 0.001)	0.733	0.001 (0.0001; 0.001)	0.016
Diabetes mellitus (ref. no)	Yes	0.001 (0.0001; 0.002)	0.020	0.0001 (-0.0003; 0.0004)	0.739
Tooth brushing frequency (ref. ≥2 times daily)	<2 times daily	0.001 (0.0003; 0.001)	0.004	0.0001 (-0.0004; 0.0005)	0.764
Electric toothbrush utilization (ref. no)	Yes	-0.012 (-0.023; -0.001)	0.030	-0.020 (-0.029; -0.011)	<0.001
Interdental cleaning aids utilization (ref. no)	Yes	-0.018 (-0.029; -0.007)	0.001	-0.012 (-0.018; -0.006)	<0.001
Dental visits frequency (ref. rarely)	≥ once a year	-0.002 (-0.004; -0.0001)	0.044	0.002 (-0.0001; 0.003)	0.066
Lifetime periodontal treatment (ref. no)	Yes	-0.00002 (-0.0004; 0.0003)	0.895	-0.018 (-0.025; -0.011)	<0.001

**Table A1.3: Detailed results from multivariate decomposition models for dentate and edentate younger seniors (65- to 74-year-olds; dependent variable: “having less than 20 teeth”; coded as yes/no; logistic models)**

		Decomposition for “Having less than 20 teeth”			
		DMS IV to DMS V (n=1870)		DMS V to DMS • 6 (n=1609)	
		Coefficient (95% CI)	Percentage	Coefficient (95% CI)	Percentage
Difference		-0.150 (-0.193; -0.108)		-0.102 (-0.147; -0.057)	
Due to difference in characteristics		-0.021 (-0.039; -0.004)	14.2%	-0.034 (-0.056; -0.013)	33.9%
Due to difference in coefficients		-0.129 (-0.175; -0.083)	85.8%	-0.067 (-0.118; -0.016)	66.1%
		<b>Model for differences in characteristics</b>		<b>Model for differences in characteristics</b>	
		Coefficient (95% CI)	P value	Coefficient (95% CI)	P value
Age, years	-	0.009 (0.003; 0.016)	0.004	0.006 (0.001; 0.011)	0.023
Gender (ref. female)	Male	0.0003 (0.0001; 0.0005)	0.003	0.0003 (-0.0001; 0.001)	0.192
School education (ref. <10 years)	10 years	-0.013 (-0.020; -0.005)	0.001	-0.005 (-0.013; 0.004)	0.282
	>10 years	-0.015 (-0.022; -0.007)	<0.001	-0.024 (-0.036; -0.013)	<0.001
Smoking status (ref. current smokers)	Former smokers	-0.009 (-0.015; -0.003)	0.003	-0.004 (-0.007; -0.001)	0.005
	Never smoked	0.025 (0.015; 0.035)	<0.001	0.009 (0.004; 0.013)	<0.001
Body Mass Index, kg/m <sup>2</sup>	-	-0.001 (-0.002; 0.001)	0.340	-0.0002 (-0.0003; -0.00005)	0.004
Diabetes mellitus (ref. no)	Yes	-0.0001 (-0.0003; -0.00004)	0.010	-0.00001 (-0.0001; 0.00004)	0.651
Dental visits frequency (ref. rarely)	≥ once a year	-0.019 (-0.028; -0.010)	<0.001	0.001 (0.0004; 0.001)	0.001
Lifetime periodontal treatment (ref. no)	Yes	0.0001 (-0.002; 0.002)	0.905	-0.016 (-0.023; -0.009)	<0.001

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