

6th German Oral Health Study (DMS • 6): research design, data collection, and statistical methods of the longitudinal study component. Online Appendix

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ABSTRACT

Objectives: Since 1989, the German Oral Health Studies (DMS) have collected nationally representative socio-epidemiologic data on oral health in Germany. For the first time, the 6th study in this series (DMS • 6) was designed as a combined cross-sectional and cohort study. The DMS • 6 cohort comprised participants from the preceding study (DMS V) who were reexamined after approximately 9 years. The primary aims of this longitudinal component of DMS • 6 were to analyze incident diseases and individual disease trajectories across the observation period and to identify antecedent risk factors.

Participants: All DMS V participants from the target population served as the sampling base for the follow-up examination in the DMS • 6 cohort (baseline; n = 3,476). After excluding individuals who declined consent to participate or were lost to follow-up or quality-neutral and systematic attrition, the final sample for the DMS • 6 cohort comprised 1,089 participants, with a retention rate of 31.3%. These participants were reassessed approximately 9 years after the baseline examination and were categorized into three age groups: adolescents (12-year-olds at baseline; 20-year-olds at follow-up), adults (35- to 44-year-olds at baseline; 43- to 52-year-olds at follow-up), and seniors (65- to 74-year-olds at baseline; 73- to 82-year-olds at follow-up).

Data collection: Baseline data were collected from October 2013 to June 2014. The mean interval between baseline and follow-up was 9.1 (\pm 0.3) years. Fieldwork and data collection for the follow-up were conducted from October 2022 to September 2023. In both study waves, data on oral health, oral-health behaviors, and sociopsychological characteristics were obtained through clinical examinations and social-science surveys conducted at temporarily established study centers.

Data processing and statistical analyses: Longitudinal statistical analyses comprised an epidemiologic description of changes in disease patterns over time based on a dataset weighted using calibrated attrition weights. The prevalence, distribution, and means of the relevant characteristics at baseline and follow-up were compared. Subsequently, the incidence (new onset) and progression (worsening) of each condition of interest were estimated. Cumulative incidence/progression and incidence/progression rates were reported. To quantify the magnitude of change, the mean difference between baseline and follow-up measurements and the annual rate of change were calculated. In addition, longitudinal association analyses were performed to evaluate the influence of participant characteristics on the changes in oral diseases.

KEYWORDS: cohort studies, data collection, data management, dental care, dental health surveys, dentists, disease progression, DMS 6, epidemiology, Germany, incidence, oral health, research design, surveys and questionnaires

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Appendix 1

Table A1.1: Participant characteristics at baseline (2014) and follow-up (2023) for the adolescent cohort

	As 12-year-olds (baseline)	As 20-year-olds (follow-up)
No. of participants (n)	371	
Age, years	11.7 ± 0.5	20.7 ± 0.5
Missing	0	0
Gender¹		
Male	200 (53.9%)	
Female	171 (46.1%)	
Missing	0	
School education¹		
< 10 years	75 (20.9%)	
10 years	143 (39.8%)	
> 10 years	141 (39.3%)	
Missing	12	
Migration history²		
With migration history	46 (13.0%)	
Without migration history	309 (87.0%)	
Missing	16	
Body mass index, kg/m²	17,7 ± 2.8	23.8 ± 4.9
Underweight	98 (26.8%)	16 (4.5%)
Normal weight	250 (68.5%)	231 (65.4%)
Overweight	13 (3.6%)	83 (23.5%)
Obesity	4 (1.1%)	23 (6.5%)
Missing	6	18
Self-assessment of oral health status		
Very good	50 (13.5%)	104 (28.2%)
Good	217 (58.6%)	208 (56.4%)
Moderate	97 (26.2%)	53 (14.4%)
Poor	6 (1.6%)	4 (1.1%)
Very poor	0 (0.0%)	0 (0.0%)
Missing	1	2
Locus of control		
Very much	169 (45.7%)	145 (39.4%)
Much	150 (40.5%)	182 (49.5%)
Some	45 (12.2%)	39 (10.6%)
Little	6 (1.6%)	2 (0.5%)
None	0 (0.0%)	0 (0.0%)
Missing	1	3

	As 12-year-olds (baseline)	As 20-year-olds (follow-up)
Dental service utilization		
Control-oriented	366 (98.9%)	326 (88.3%)
Complaint-oriented	4 (1.1%)	43 (11.7%)
Missing	1	2
Dental visits (frequency)		
Within the last year	367 (98.9%)	321 (87.2%)
More than 1 year ago	4 (1.1%)	47 (12.8%)
Missing	0	3
Tooth brushing (frequency)		
≥ 2 times daily	318 (85.7%)	317 (85.9%)
< 2 times daily	53 (14.3%)	52 (14.1%)
Missing	0	2
Type of toothbrush used		
Electric	92 (24.8%)	125 (33.9%)
Manual	186 (50.1%)	205 (55.6%)
Both	91 (24.5%)	29 (7.9%)
None	2 (0.5%)	10 (2.7%)
Missing	0	2
Interdental cleaning (utilization)		
Yes	137 (36.9%)	180 (48.8%)
No	234 (63.1%)	189 (51.2%)
Missing	0	2
Interdental cleaning aids		
None	234 (63.1%)	189 (51.2%)
Dental floss	73 (19.7%)	131 (35.5%)
Tooth sticks	19 (5.1%)	7 (1.9%)
Interdental brushes	24 (6.5%)	19 (5.1%)
Multiusers	21 (5.7%)	23 (6.2%)
Missing	0	2
Flouridated salt use		
Yes	261 (70.7%)	217 (71.6%)
No	65 (17.6%)	39 (12.9%)
Don't know	43 (11.7%)	47 (15.5%)
Missing	2	67

Data are presented as number (percentage) or mean ± standard deviation based on unweighted data

¹Baseline measurement.

²Follow-up measurement.

Table A1.2: Participant characteristics at baseline (2014) and follow-up (2023) for the adult cohort

	As 35- to 44-year-olds (Baseline)	As 43- to 52-year-olds (Follow-up)
No. of participants (n)	342	
Age, years	40.0 ± 2.8	49.0 ± 2.6
Missing	2	0
Gender¹		
Male	159 (46.5%)	
Female	183 (53.5%)	
Missing	0	
School education¹		
< 10 years	32 (9.4%)	
10 years	150 (43.9%)	
> 10 years	160 (46.8%)	
Missing	0	
Migration history²		
With migration history	37 (11.6%)	
Without migration history	281 (88.4%)	
Missing	24	
Body mass index, kg/m²	25.9 ± 5.5	26.7 ± 5.1
Underweight	5 (1.5%)	2 (0.6%)
Normal weight	178 (52.7%)	135 (42.3%)
Overweight	106 (31.4%)	118 (37.0%)
Obesity	49 (14.5%)	64 (20.1%)
Missing	4	23
Self-assessment of oral health status		
Very good	33 (9.6%)	53 (15.5%)
Good	158 (46.2%)	208 (60.8%)
Moderate	130 (38.0%)	67 (19.6%)
Poor	20 (5.8%)	12 (3.5%)
Very poor	1 (0.3%)	2 (0.6%)
Missing	0	0
Locus of control		
Very much	153 (44.9%)	122 (35.8%)
Much	150 (44.0%)	155 (45.5%)
Some	37 (10.9%)	59 (17.3%)
Little	1 (0.3%)	5 (1.5%)
None	0 (0.0%)	0 (0.0%)
Missing	1	1
Dental service utilization		
Control-oriented	327 (96.2%)	323 (94.4%)
Complaint-oriented	13 (3.8%)	19 (5.6%)
Missing	2	0

	As 35- to 44-year-olds (Baseline)	As 43- to 52-year-olds (Follow-up)
Dental visits (frequency)		
Within the last year	309 (91.2%)	315 (92.1%)
More than 1 year ago	30 (8.8%)	27 (7.9%)
Missing	3	0
Tooth brushing (frequency)		
≥ 2 times daily	286 (83.6%)	293 (85.7%)
< 2 times daily	56 (16.4%)	49 (14.3%)
Missing	0	0
Type of toothbrush used		
Electric	141 (41.2%)	175 (51.2%)
Manual	139 (40.6%)	121 (35.4%)
Both	61 (17.8%)	41 (12.0%)
None	1 (0.3%)	5 (1.5%)
Missing	0	0
Interdental cleaning (utilization)		
Yes	235 (68.7%)	259 (75.7%)
No	107 (31.3%)	83 (24.3%)
Missing	0	0
Interdental cleaning aids		
None	107 (31.3%)	83 (24.3%)
Dental floss	141 (41.2%)	136 (39.8%)
Tooth sticks	14 (4.1%)	8 (2.3%)
Interdental brushes	20 (5.8%)	33 (9.6%)
Multiuser	60 (17.5%)	82 (24.0%)
Missing	0	0
Lifetime periodontal treatment		
Yes	59 (17.3%)	60 (17.5%)
No / don't know	282 (82.7%)	282 (82.5%)
Missing	1	0
Professional tooth cleaning (regular utilization)		
≥ once a year	92 (26.9%)	215 (62.9%)
< once a year / don't know	250 (73.1%)	127 (37.1%)
Missing	0	0
Smoking status		
Current smoker	80 (23.4%)	60 (17.5%)
Former smoker	67 (19.6%)	78 (22.8%)
Never smoked	195 (57.0%)	204 (59.6%)
Missing	0	0

	As 35- to 44-year-olds (Baseline)	As 43- to 52-year-olds (Follow-up)
Flouridated salt use		
Yes	239 (70.5%)	236 (77.9%)
No	57 (16.8%)	56 (18.5%)
Don't know	43 (12.7%)	11 (3.6%)
Missing	3	39

Data are presented as number (percentage) or mean \pm standard deviation based on unweighted data

¹Baseline measurement.

²Follow-up measurement.

Table A1.3: Participant characteristics at baseline (2014) and follow-up (2023) for the senior cohort

	As 65- to 74-year-olds (Baseline)	As 73- to 82-year-olds (Follow-up)
No. of participants (n)	373	
Age, years	69.1 ± 3.1	78.1 ± 3.1
Missing	0	0
Gender¹		
Male	177 (47.5%)	
Female	196 (52.5%)	
Missing	0	
School education¹		
< 10 years	149 (42.1%)	
10 years	103 (29.1%)	
> 10 years	102 (28.8%)	
Missing	19	
Migration history²		
With migration history	36 (10.3%)	
Without migration history	314 (89.7%)	
Missing	23	
Bod mass index, kg/m²	26.9 ± 4.4	26.8 ± 5.6
Underweight	1 (0.3%)	3 (0.9%)
Normal weight	124 (33.9%)	139 (41.5%)
Overweight	174 (47.5%)	128 (38.2%)
Obesity	67 (18.3%)	65 (19.4%)
Missing	7	38
Self-assessment of oral health status		
Very good	27 (7.3%)	28 (7.5%)
Good	157 (42.4%)	220 (59.3%)
Moderate	148 (40.0%)	97 (26.1%)
Poor	31 (8.4%)	22 (5.9%)
Very poor	7 (1.9%)	4 (1.1%)
Missing	3	2
Locus of control		
Very much	148 (39.7%)	88 (23.8%)
Much	148 (39.7%)	163 (44.2%)
Some	71 (19.0%)	105 (28.5%)
Little	4 (1.1%)	9 (2.4%)
None	2 (0.5%)	4 (1.1%)
Missing	0	4
Dental service utilization		
Control-oriented	355 (95.2%)	325 (87.6%)
Complaint-oriented	18 (4.8%)	46 (12.4%)
Missing	0	2

	As 65- to 74-year-olds (Baseline)	As 73- to 82-year-olds (Follow-up)
Dental visits (frequency)		
Within the last year	349 (94.8%)	333 (90.7%)
More than 1 year ago	19 (5.2%)	34 (9.3%)
Missing	5	6
Tooth brushing (frequency)		
≥ 2 times daily	291,0 (83,1 %)	273,0 (82,5 %)
< 2 times daily	59,0 (16,9 %)	58,0 (17,5 %)
Missing	36	42
Type of toothbrush used		
Electric	100,0 (28,6 %)	100,0 (30,2 %)
Manual	202,0 (57,7 %)	186,0 (56,2 %)
Both	38,0 (10,9 %)	35,0 (10,6 %)
None	10,0 (2,9 %)	10,0 (3,0 %)
Missing	36	42
Interdental cleaning (utilization)		
Yes	214,0 (61,1 %)	183,0 (55,3 %)
No	136,0 (38,9 %)	148,0 (44,7 %)
Missing	36	42
Interdental cleaning aids		
None	136,0 (38,9 %)	148,0 (44,7 %)
Dental floss	45,0 (12,9 %)	35,0 (10,6 %)
Tooth sticks	24,0 (6,9 %)	8,0 (2,4 %)
Interdental brushes	81,0 (23,1 %)	91,0 (27,5 %)
Multiuser	64,0 (18,3 %)	49,0 (14,8 %)
Missing	36	42
Lifetime periodontal treatment		
Yes	157 (42.5%)	101 (27.4%)
No / don't know	212 (57.5%)	267 (72.6%)
Missing	4	5
Professional tooth cleaning (frequency)³		
≥ once a year	113,0 (32,9 %)	182,0 (54,8 %)
< once a year / don't know	230,0 (67,1 %)	150,0 (45,2 %)
Missing	43	41
Smoking status³		
Current smoker	30 (8.1%)	NA
Former smoker	126 (33.9%)	
Never smoked	216 (58.1%)	
Missing	1	373

	As 65- to 74-year-olds (Baseline)	As 73- to 82-year-olds (Follow-up)
Flouridated salt use		
Yes	241 (65.3%)	250 (75.3%)
No	68 (18.4%)	60 (18.1%)
Don't know	60 (16.3%)	22 (6.6%)
Missing	4	41

Data are presented as number (percentage) or mean \pm standard deviation based on unweighted data

¹Baseline measurement.

²Follow-up measurement.

³Only for dentate study participants.

⁴In this age group, the smoking status was measured only at baseline.

Appendix 2

Table A2.1: Participant characteristics at baseline (2014) for younger adolescents (12-year-olds)

	12-year-olds		
	All baseline participants, weighted sample	Baseline and follow-up participants, unweighted sample	Baseline and follow-up participants, weighted sample
No. of participants	1,468	371	371
Gender			
Male	51.3%	53.9%	52.6%
Female	48.7%	46.1%	47.4%
School education			
< 10 years	35.3%	20.9%	33.7%
10 years	29.9%	39.8%	31.1%
> 10 years	34.8%	39.3%	35.2%
Body mass index, kg/m²	18.1 ± 3.0	17.7 ± 2.8	17.9 ± 2.9
Underweight	23.4%	26.8%	25.6%
Normal weight	68.9%	68.5%	68.9%
Overweight	5.8%	3.6%	3.6%
Obesity	1.9%	1.1%	2.0%
Self-assessment of oral health status			
Very good	11.0%	13.5%	12.7%
Good	56.0%	58.6%	56.2%
Moderate	28.8%	26.2%	28.2%
Poor	3.8%	1.6%	2.8%
Very poor	0.3%	0.0%	0.0%
Locus of control			
Very much	43.2%	45.7%	41.9%
Much	42.7%	40.5%	42.7%
Some	12.3%	12.2%	14.0%
Little	1.5%	1.6%	1.4%
None	0.2%	0.0%	0.0%
Dental service utilization			
Control-oriented	95.3%	98.9%	97.9%
Complaint-oriented	4.7%	1.1%	2.1%
Dental visit frequency			
Within the last year	94.9%	98.9%	97.5%
More than 1 year ago	5.1%	1.1%	2.5%
Tooth brushing frequency			
≥ 2 times daily	82.2%	85.7%	81.3%
< 2 times daily	17.8%	14.3%	18.7%

	12-year-olds		
	All baseline participants, weighted sample	Baseline and follow-up participants, unweighted sample	Baseline and follow-up participants, weighted sample
Type of toothbrush used			
Manual	54.0%	50.1%	51.5%
Electric	24.7%	24.8%	25.9%
Both	21.0%	24.5%	21.9%
None	0.3%	0.5%	0.7%
Interdental cleaning			
Yes	33.4%	36.9%	37.9%
No	66.6%	63.1%	62.1%
Interdental cleaning aids			
None	66.6%	63.1%	62.1%
Dental floss	18.8%	19.7%	20.5%
Tooth sticks	5.1%	5.1%	5.7%
Interdental brushes	5.8%	6.5%	5.7%
Multiuser	3.8%	5.7%	6.0%
Flouridated salt use			
Yes	68.1%	70.7%	70.2%
No	17.9%	17.6%	17.2%
Don't know	14.0%	11.7%	12.6%

Data are presented as unweighted numbers (n) and as weighted or unweighted percentages or means \pm standard deviation.

Table A2.2: Participant characteristics at Baseline (2014) for younger adults (35- to 44-year-olds)

	35- to 44-year-olds		
	All baseline participants, weighted sample	Baseline and follow-up participants, unweighted sample	Baseline and follow-up participants, weighted sample
No. of participants (n)	966	342	342
Gender			
Male	50.2%	46.5%	53.6%
Female	49.8%	53.5%	46.4%
School education			
< 10 years	26.5%	9.4%	27.0%
10 years	36.3%	43.9%	36.3%
> 10 years	37.2%	46.8%	36.7%
Body mass index, kg/m²	26.2 ± 5.2	25.5 ± 4.6	25.9 ± 5.5
Underweight	2.3%	1.5%	1.3%
Normal weight	45.5%	52.7%	52.2%
Overweight	32.2%	31.4%	30.5%
Obesity	20.0%	14.5%	16.0%
Self-assessment of oral health status			
Very good	6.7%	9.6%	7.8%
Good	39.0%	46.2%	36.6%
Moderate	37.5%	38.0%	42.3%
Poor	13.6%	5.8%	12.7%
Very poor	3.1%	0.3%	0.6%
Locus of control			
Very much	39.5%	44.9%	40.6%
Much	45.9%	44.0%	47.8%
Some	13.1%	10.9%	11.3%
Little	1.4%	0.3%	0.4%
None	0.0%	0.0%	0.0%
Dental service utilization			
Control-oriented	87.2%	96.2%	88.1%
Complaint-oriented	12.8%	3.8%	11.9%
Dental visit frequency			
Within the last year	83.9%	91.2%	81.4%
More than 1 year ago	16.1%	8.8%	18.6%
Tooth brushing frequency			
≥ 2 times daily	80.0%	83.6%	78.9%
< 2 times daily	20.0%	16.4%	21.1%

	35- to 44-year-olds		
	All baseline participants, weighted sample	Baseline and follow-up participants, unweighted sample	Baseline and follow-up participants, weighted sample
Type of toothbrush used			
Manual	51.8%	40.6%	40.5%
Electric	31.9%	41.2%	40.8%
Both	15.2%	17.8%	18.6%
None	1.1%	0.3%	0.2%
Interdental cleaning			
Yes	61.0%	68.7%	69.0%
No	39.0%	31.3%	31.0%
Interdental cleaning aids			
None	39.0%	31.3%	31.0%
Dental floss	33.8%	41.2%	38.1%
Tooth sticks	5.4%	4.1%	6.7%
Intedental brushes	7.0%	5.8%	7.7%
Multiusers	14.9%	17.5%	16.5%
Lifetime periodontal treatment			
Yes	20.3%	17.3%	20.9%
No / don't know	79.7%	82.7%	79.1%
Professional tooth cleaning (frequency)			
≥ once a year	22.0%	26.9%	26.6%
< once a year / don't know	78.0%	73.1%	73.4%
Smoking status			
Current smoker	30.0%	19.6%	30.4%
Former smoker	25.9%	23.4%	23.3%
Never smoked	44.1%	57.0%	46.4%
Flouridated salt use			
Yes	64.8%	70.5%	70.3%
No	18.7%	16.8%	15.8%
Don't know	16.5%	12.7%	14.0%

Data are presented as unweighted numbers (n) and as weighted or unweighted percentages or means ± standard deviation

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