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6th German Oral Health Study (DMS • 6): rationale, study design and baseline characteristics. Online Appendix

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ABSTRACT

Objectives: With the First German Oral Health Study (DMS I) in 1989, the Institut der Deutschen Zahnärzte (IDZ) laid the foundation for a population-representative socioepidemiologic monitoring of oral health and care status in Germany. The objective of the sixth wave of the survey was to update the status of oral health.

Research questions: The primary questions address cross-sectional data: 1. What are the current prevalence rates of oral diseases? 2. What associations exist between oral health and other participant characteristics? The third question is based on the comparison of cross-sectional data with previous German oral health studies (trend): 3. How has the oral health and care status in Germany developed from 1989 to 2023? The last two questions require longitudinal data: 4. How do oral diseases change over the course of a lifetime? 5. What individual characteristics influence the progression of (new) oral diseases?

Study design: The DMS • 6 is a combined cross-sectional and cohort study and therefore classified as an observational study.

Study participants: The age groups for the cross-sectional study were selected following the World Health Organization (WHO) recommendations for oral epidemiologic studies. These include 12-year-olds as representatives for younger adolescents, 35- to 44-year-olds for younger adults, and 65- to 74-year-olds for younger seniors. An additional age group of 8- and 9-year-olds (younger children) was included to obtain information on oral health during the mixed dentition phase. In total, 3,377 study participants were included in the analyses for the cross-sectional questions (prevalences). Participant characteristics provide insights into their sociodemographic and behavioral parameters.

KEYWORDS: cross-sectional studies, dental care, dental health surveys, dentists, DMS 6, epidemiology, Germany, oral health, prevalence, research design

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Appendix 1

Sample size planning

The sample size of the cross-sectional arm of the DMS • 6 should be sufficient for answering the cross-sectional questions about the current prevalence of oral diseases in Germany. On the other hand, consideration should be given to ensuring that sufficient study participants can also be invited for a possible follow-up survey (DMS • 7), for example, in 2030. The original sample size planning for the groups of younger adolescents, younger adults and younger senior citizens was adjusted after 60% of the points had been completed since the sample size realised up to this point had fallen far short of the expected sample size and a successful conclusion of the study could not otherwise be guaranteed. The adjusted sample size planning is described below.

Cross-section

It should be ensured that the standard error of the prevalence is a maximum of 10% of the prevalence itself in order to obtain a reliable estimate of the prevalence (1). The ratio of standard error of prevalence to prevalence is referred to here as precision. It is expressed using confidence intervals (high precision = narrow confidence intervals).

Younger children (8- and 9-year-olds)

The estimation of the prevalence of dental and jaw misalignments in the three categories KIG 1, KIG 2 and KIG 3-5 was of primary interest. A 1999 clinical-epidemiological study of 226 schoolchildren in years 4 and 5 (9- to 13-year-olds) reported KIG 1 in 13.8% of cases, KIG 2 in 34.6% and KIG 3-5 in 51.6% (National Association of Statutory Health Insurance Dentists' (KZBV) own data, not published). Further epidemiological studies of primary school pupils have revealed percentages ranging from 54% to 59% for KIG 1-2 and from 41% to 46% for KIG 3-5 (2, 3). This data always related to children with at least KIG 1; no account was taken of children with eugnathic dentition.

A prevalence of 13% for KIG 1 was assumed for sample size planning based on the published data. 670 participants are needed in order to estimate an expected prevalence of 13% at a confidence level of 95% with a standard error of 1.3% (precision 10%).

The following results can be achieved with a sample size of 670 participants:

- Prevalence 13%: 95% confidence interval 10.5-15.5% (precision 10%)
- Prevalence 35%: 95% confidence interval 31.4–38.6% (precision 5.3%)
- Prevalence 50%: 95% confidence interval 46.2–53.8% (precision 3.9%)

Younger adolescents (12-year-olds) and younger adults (35- to 44-year-olds)

Unlike in the group of younger children, no primary endpoint was relevant for sample size planning in the group of younger adolescents and younger adults. In fact, it should be possible to make reliable estimates of the prevalence of all oral diseases of interest for these age groups. 900 participants per age group were to be included in the study so that even low prevalences of 10% could be estimated with a confidence level of 95% and a precision of 10%.

The following results can be achieved with a sample size of 900 participants:

- Prevalence 10%: 95% confidence interval 8.2–12.1% (precision 10.0%)
- Prevalence 30%: 95% confidence interval 27.1–33.1% (precision 5.1%)
- Prevalence 50%: 95% confidence interval 46.7–53.3% (precision 3.3%)

Younger seniors (65- to 74-year-olds)

Periodontal disease and edentulism were the main diseases among 65- to 74-year-olds. The estimated prevalences as per DMS V were 12.4% for edentulism, 19.8% for severe periodontal disease according to the CDC/AAP classification and 24.6% for severe periodontal disease according to the Community Periodontal Index (4). 750 senior citizens should be included in the study so that a prevalence of 12% can be estimated at a confidence level of 95% with a maximum precision of 10%.

The following results can be achieved with a sample size of 750 participants:

- Prevalence 12%: 95% confidence interval 9.9–14.5% (precision 9.9%)
- Prevalence 30%: 95% confidence interval 26.8–33.4% (precision 5.6%)
- Prevalence 50%: 95% confidence interval 46.4–53.6% (precision 3.7%)

Planned re-survey

The younger children and the younger adults were included in a panel for a potential re-survey in around 2030. The sample size calculations are based on panel data of the DMS V. The assumption was made that 95% of participants fulfil the inclusion criteria for inclusion in the panel. Assuming an annual lost-to-follow-up rate of 3% and a response rate of 50% and 70%, respectively, the estimated gross sample size for the group of younger children, calculated on the basis of the planned 670 participants in 2021, was 483 available persons in 2030 and an estimated net sample size of 241 (483 x 0.5) and 338 (483 x 0.7) persons respectively who would actually participate in the re-survey. For the younger adults, an estimated gross sample size of n = 670 in 2030, as well as an estimated

net sample size of n = 335 (670 x 0.5) and n = 469 (670 x 0.7), were calculated based on 900 people in 2022.
The calculations were conducted with R-Version 3.5.3, using the package "samplingbook", function "sample.size.prob".

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Appendix 2

Table A2.1 – Quality-neutral dropouts

Quality-neutral dropouts										
	Total		8– and 9-year-olds		12-year-olds		35– to 44-year-olds		65– to 74-year-olds	
Reason for dropout	n	%	n	%	n	%	n	%	n	%
Moved, no longer residing at the household address	543	34,9%	28	21,1%	74	27,6%	364	50,6%	77	17,7%
Unavailable due to acute illness	272	17,5%	37	27,8%	78	29,1%	64	8,9%	93	21,3%
Unable to locate address	271	17,4%	33	24,8%	71	26,5%	140	19,4%	27	6,2%
Unavailable due to chronic illness, physical, or mental disability	164	10,5%	10	7,5%	10	3,7%	19	2,6%	125	28,7%
Not proficient in the German language	214	13,7%	14	10,5%	30	11,2%	121	16,8%	49	11,2%
Deceased	29	1,9%	0	0,0%	2	0,7%	3	0,4%	24	5,5%
Unavailable due to hospitalization	28	1,8%	0	0,0%	0	0,0%	4	0,6%	24	5,5%
Unavailable due to participation in rehabilitation	17	1,1%	0	0,0%	1	0,4%	3	0,4%	13	3,0%
Unavailable due to quarantine during the SARS-CoV-2 pandemic (not personally infected)	19	1,2%	11	8,3%	2	0,7%	2	0,3%	4	0,9%
Total	**1557**	**100**	**133**	**100**	**268**	**100**	**720**	**100**	**436**	**100**

Table A2.2 – Systematic dropouts

Systematic dropouts										
	Total		8– and 9-year-olds		12-year-olds		35– to 44-year-olds		65– to 74-year-olds	
Reason for dropout	n	%	n	%	n	%	n	%	n	%
Never reached, fewer than 3 contact attempts	3551	37,7%	234	22,4%	831	44,3%	1599	44,0%	887	31,1%
No information about the contact person, never reached	1658	17,6%	211	20,2%	330	17,6%	713	19,6%	404	14,2%
No willingness to participate, no reason provided	1687	17,9%	179	17,1%	281	15,0%	487	13,4%	740	25,9%
No willingness to participate due to lack of time	517	5,5%	50	4,8%	86	4,6%	286	7,9%	95	3,3%
Strict refusal to participate, no reason provided, total refusal	492	5,2%	65	6,2%	66	3,5%	168	4,6%	193	6,8%
On vacation/traveling, unavailable until	266	2,8%	3	0,3%	18	1,0%	78	2,1%	167	5,9%
Unavailable due to other reasons	249	2,6%	12	1,1%	60	3,2%	86	2,4%	91	3,2%
No willingness to participate due to other reasons	250	2,7%	0	0,0%	91	4,9%	55	1,5%	104	3,6%
Respondent did not appear for the scheduled appointment, no information provided regarding reasons	275	2,9%	79	7,6%	70	3,7%	84	2,3%	42	1,5%
No willingness to participate, not convinced of the purpose or value	155	1,6%	42	4,0%	20	1,1%	26	0,7%	67	2,3%
Strict refusal to participate due to privacy concerns	80	0,9%	13	1,2%	15	0,8%	22	0,6%	30	1,1%
Never directly reached the contact person/guardian (other contact person)	57	0,6%	0	0,0%	3	0,2%	28	0,8%	26	0,9%
Refusal due to concerns related to the SARS-CoV-2 pandemic	160	1,7%	151	14,4%	2	0,1%	4	0,1%	3	0,1%
All appointments taken/waiting list	6	0,1%	0	0,0%	1	0,1%	2	0,1%	3	0,1%
Respondent or research team terminated the study	7	0,1%	6	0,6%	1	0,1%	0	0,0%	0	0,0%
Total	**9410**	**100**	**1045**	**100**	**1875**	**100**	**3638**	**100**	**2852**	**100**

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