6th German Oral Health Study (DMS • 6): fieldwork, data collection, and quality assurance

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Objectives: The German Oral Health Studies (DMS) are nationally representative surveys on oral health in Germany, conducted approximately every 8 years since 1989. The current sixth edition of the study (DMS • 6) was planned and executed in accordance with international standards. A field institute selected from across Europe was responsible for data collection. **Method and materials:** For six age groups, data collection for the DMS • 6 took place across Germany from October 2022 to September 2023. Data for a seventh age group had already been collected earlier, in the spring of 2021. In addition to conducting a cross-sectional study with new participants, for the first time, a longitudinal component was included by reengaging study participants from the previous study, the Fifth German Oral Health Study (DMS V). Participation was organized via postal invitations, followed by reminder letters or personal visits if there was no response. Data collection in the field was conducted at temporarily established study centers. **Data collection:** The primary aim of the DMS • 6 was to assess the current oral health status, oral health behavior, and the dental care status in Germany. For this purpose, both new study participants and participants from the preceding DMS V study underwent clinical examinations and social science surveys. The clinical examinations followed a standardized protocol outlined in a manual. The social science survey was conducted in two parts: a paper and pencil interview (PAPI) completed at home and a computer-assisted personal interview (CAPI) administered immediately before the clinical examination in the study center. A non-response survey showed no systematic differences between study participants and non-participants, indicating an unbiased data basis. **Quality assurance:** The DMS • 6 included a comprehensive examination program supported by a multi-stage quality assurance system. This system involved pre-testing of the social science research instruments, conducting a pilot study to simulate the main study, multiple training sessions, and the calibration and certification of the dental study personnel both before and during fieldwork. This ensured a high level of data validity. *(Quintessence Int 2025;56 (Suppl):S14–S21; doi: 10.3290/j.qi.b5981986)*

Keywords: data collection, dental care, dental health surveys, dentists, DMS 6, epidemiology, surveys and questionnaires

The German Oral Health Studies (DMS) are oral epidemiologic surveys aimed at reporting the state of oral health in Germany. They are the only nationally representative studies of their kind. Since 1989, the oral health of selected individuals has been assessed approximately every 8 years. This complements the federal government's epidemiologic health reporting in Germany.[1]

Following a Europe-wide call for tenders, the field institute Cerner Enviza (now Oracle Life Sciences) in Munich was identified to conduct this sixth edition of the study, being primarily responsible for recruiting study participants and collecting data. The collaboration between the field institute and project management was marked by regular and intensive consultations.

The 6th German Oral Health Study (DMS • 6) included a comprehensive examination program, accompanied by a multi-stage quality assurance system. In particular, the detailed training of the study personnel and reliability testing before and during the study were essential. These measures ensured that any measurement distortions were promptly identified and appropriate countermeasures implemented. The study adhered to current international standards for dental and social science data collection.[2,3]

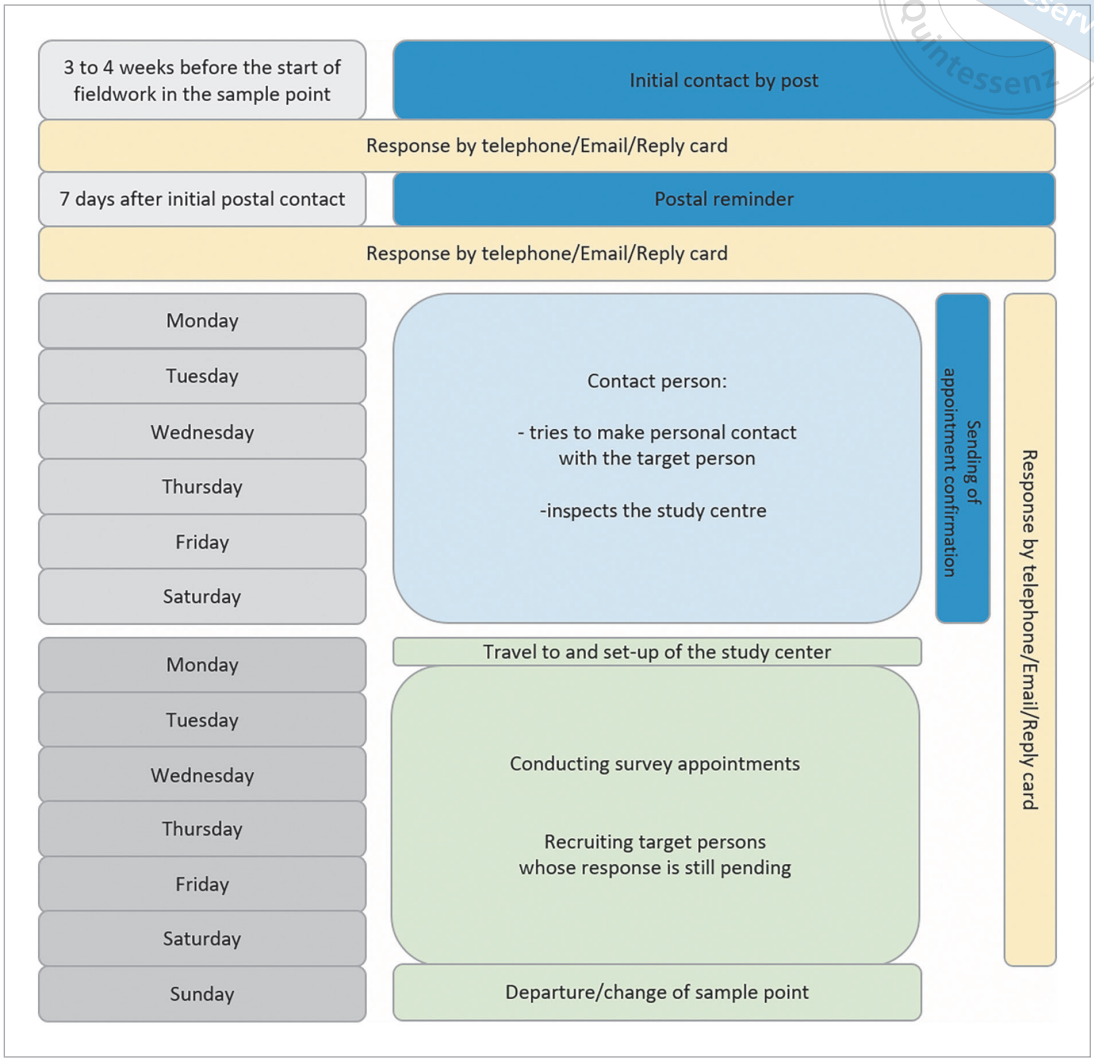

Fig 1 Schematic representation of fieldwork for a sample point.

Method and materials

The DMS • 6 has been approved by the Institutional Review Board of the Witten/Herdecke University, Witten, Germany (registration number S-249/2021). This study is registered at the German Clinical Trials Register (registration number DRKS00028701). Further details regarding research objectives, study design, and characteristics of the study participants are published elsewhere.[4]

Recruiting study participants

The main survey of the DMS • 6 began on 4 October 2022, and continued until 22 July 2023. During this period, the study teams traveled simultaneously across Germany to conduct clinical examinations and social science interviews with study participants from six age groups in 90 study centers.[4,5] Each study team consisted of a contact person, a dental practitioner, and an interviewer. Throughout the entire field phase, four contact persons, five dental practitioners, and six interviewers were involved in data collection.

The six age groups surveyed from October 2022 to July 2023 included:

- younger adolescents (12-year-olds)
- older adolescents (20-year-olds)
- younger adults (35- to 44-year-olds)
- older adults (43- to 52-year-olds)
- younger seniors (65- to 74-year-olds)
- older seniors (73- to 82-year-olds).

A subsequent data collection took place immediately after the main survey, continuing until 23 September 2023, aimed at achieving the targeted net number of cases in the group of younger adults. For organizational and health policy reasons, the clinical examinations and social science surveys for a sev-

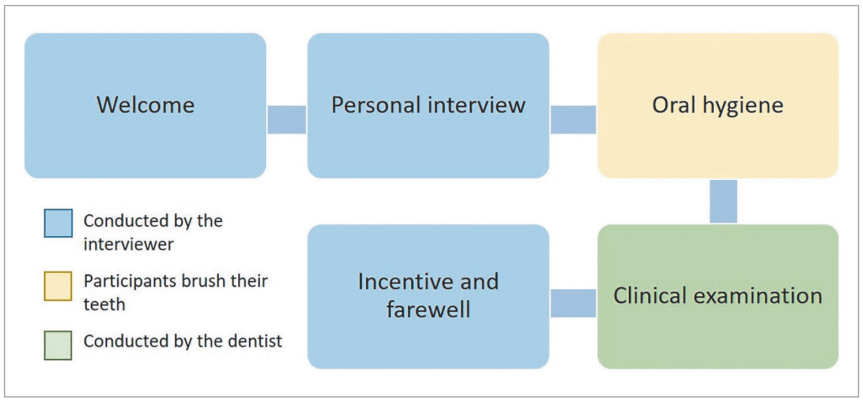

Fig 2 Organization of processes in the study center from the perspective of the study participants.

enth age group (younger children: 8- and 9-year-olds) were conducted beforehand in the spring of 2021 and were described in detail elsewhere.[6,7]

For the first time, in addition to examining new study participants (the cross-sectional component of the DMS • 6), a repeated examination of participants from the DMS V was conducted (the longitudinal component of the DMS • 6). The age groups of younger children, younger adolescents, younger adults, and younger seniors were examined cross-sectionally, allowing for the determination of oral epidemiologic disease prevalences. The age groups of older adolescents, older adults, and older seniors were part of the DMS V study panel, enabling the determination of incidence rates; results will be reported in spring 2026.

Conducting fieldwork

Figure 1 provides a schematic overview of the fieldwork conducted at one sample point. Postal invitations to participate in the study were coordinated with a route plan defined at the start of the study. Four weeks prior to the fieldwork, the identified target individuals or their legal guardians received an invitation letter to visit the study center. Along with it, they received an information sheet about the study. The field institute maintained a free telephone hotline for study participants to address queries regarding the study or to arrange individual appointments. Additionally, study participants could respond via email or by using a reply card included with the invitation letter. If no response was received within 7 days of sending the invitation, a reminder letter was dispatched. Study participants who confirmed their attendance received appointment confirmations by post, which included the consent form, the data protection sheet, and a paper questionnaire to be completed by the study participant. These documents were to be brought along to the examination appointment. If a mobile number was provided, a reminder was sent via SMS the day before the appointment. Individuals who did not respond to either the invitation or reminder letters were visited in person by a contact person in the week prior to the planned examination week to arrange an appointment.

The study team spent 2 weeks on-site for each sample point. In the first week, the contact person inspected the rented premises where the temporary study center would be established. It was ensured that there were at least two rooms or one large room that could be divided by screens. The premises were located in public buildings such as hotels, office buildings, youth hostels, or similar venues.

During the second week, the interviewer and dental practitioner were on-site to conduct the surveys and examinations over a period of 6 days. On the morning of the first day, the study center was set up, which included an interview area, a mobile tooth brushing station, and an area for clinical examinations. Upon arrival at the study center, the study participants were guided through the planned examination program by the study team. Figure 2 illustrates this process from the perspective of the study participants.

Initially, the interviewer welcomed the study participants and, if applicable, their accompanying persons. After this welcome, the interviewer collected the data protection sheet, the declaration of consent, and the completed paper questionnaire that had been sent to the study participant's home address in advance. Following this, a computer-assisted personal interview (CAPI) was conducted. In preparation for the clinical examination, the study participants were then asked to brush their teeth at the mobile tooth brushing station. Study participants were encouraged to bring and use their own dental care items,

Table 1 Clinical examinations by age group

Examination	12-year-olds	20-year-olds	35- to 44-year-olds	43- to 52-year-olds	65- to 74-year-olds	73- to 82-year-olds
Dental findings	x	x	x	x	x	x
Periodontal findings	—	x	x	x	x	x
Caries	x	x	x	x	x	x
Root caries	—	—	x	x	x	x
Molar-incisor hypomineralization (MIH)	x	x	—	—	—	—
Erosions	—	x	x	x	—	—
Dentures	—	—	x	x	x	x
Oral mucosa findings	—	—	—	—	x	x
Plaque	x	x	x	x	x	x
Oral functional capacity	—	—	—	—	x	x

x, recorded; —, not recorded.

though alternatives were provided. For selected age groups (12-year-olds, 20-year-olds, 35- to 44-year-olds, and 65- to 74-year-olds), tooth brushing was filmed in a standardized manner for further evaluation, provided the study participants consented. Afterward, the dental practitioner conducted the clinical examination, recording clinical data in input masks on a laptop. At times, the interviewer assisted the dental practitioner. After their visit, the study participants received a monetary incentive.

Data collection

The primary aim of the DMS • 6 data collection was to assess the current oral health status, oral health behavior, and the dental care status. To achieve this, a clinical examination, a paper and pencil interview (PAPI), and a CAPI were conducted. The characteristics to be recorded were selected based on contemporary oral epidemiologic standards. Efforts were also made to ensure sufficient compatibility with the previous DMS study; however, due to methodologic developments, direct comparability with DMS V is not fully achievable in all aspects.[8] The project management team, in collaboration with an international and interdisciplinary group of experts, defined both the dental and the social science study endpoints.[9]

The study endpoints for the six aforementioned age groups are presented below. The dental and social science data collection for the seventh age group of younger children (8- and 9-year-olds) has been described in detail elsewhere.[6,7] Detailed information on data processing and statistical analysis has also been published elsewhere.[10]

Collecting dental data

The clinical examination program included dental findings, periodontal findings, caries, root caries, molar-incisor hypomineralization (MIH), erosions, dentures, oral mucosa findings, plaque, and oral functional capacity. An overview of the recorded study endpoints by age group can be found in Table 1. The criteria for clinical data collection regarding the dental study endpoints were detailed in a manual for clinical examination.[11] Standardized work instructions for conducting the examinations by the study dental practitioners were derived from this manual. The data were recorded electronically using the specially created program DentaSoft 6.

Since data collection in the field could not occur under the same conditions as in a dental practice, all necessary precautions were taken to ensure the highest possible quality of the examination. The examination room was set up to meet the requirements of a clinical examination. A basic examination chair allowing the study participants to be placed in a semi-reclined position was situated near a window, avoiding direct sunlight. Because no suction was available, study participants were permitted to swallow regularly during the examination. Additionally, as saliva removal using compressed air was also not possible, dental cotton rolls were used to manage saliva. As is usual in clinical examinations, further details were attended to once the study participants were positioned. For instance, the available headlamp and floor lamp were adjustable for the examination of both the maxillary and mandibular arches. Disposable instruments, such as the Variator Dental Kit and Brillant No. 5 Dispos-

Table 2 Social science topics by age group

Interview mode	Topic	12-year-olds	20-year-olds	35- to 44-year-olds	43- to 52-year-olds	65- to 74-year-olds	73- to 82-year-olds
Paper and pencil interview (PAPI)	Fluoride prophylaxis	x	x	x	x	x	x
	Health economics	x	x	x	x	x	x
	Migration	x	x	x	x	x	x
	Oral health-related quality of life	x	x	x	x	x	x
	Disability and need for care	(x)	(x)	(x)	(x)	x	x
	Sociodemographics	x	x	x	x	x	x
	Socioeconomic status	x	x	x	x	x	x
	Dental anxiety	—	x	x	x	x	x
	Sugar consumption	x	x	x	x	x	x
Computer assisted personal interview (CAPI)	Health literacy	—	x	x	x	x	x
	Home care services	—	—	—	—	x	x
	Dental service utilization	x	x	x	x	x	x
	Cardiometabolic diseases	—	—	x	x	x	x
	Medical geography	—	x	x	x	x	x
	Oral hygiene behavior	x	x	x	x	x	x
	Smoking status	—	x	x	x	x	—
	Self-assessment of health status	x	x	x	x	x	x
	Health services research	—	x	x	x	x	x
	Orthodontic treatment	x	x	x	x	x	x
	Full denture wearer	—	—	—	—	x	x

x, recorded; —, not recorded; (), reduced inclusion.

able dental mirror (Hager & Werken), as well as sterilized instruments such as the periodontal probe PCPUNC 15 (Zantomed) for periodontal measurements, were utilized. The study adhered to general hygiene requirements for clinical examination procedures to prevent infections or cross-infections.

Collecting social science data

The social science survey comprised two separate interviews conducted at different times and utilizing different modes. The aim of this two-part design was to employ the most suitable mode for each question. Furthermore, this approach also enabled the inclusion of more questions across two shorter interviews than would have been feasible in a single, longer questionnaire. One single, longer questionnaire would have required shortening to minimize dropouts.

The first part of the social science data collection involved an age-specific paper questionnaire for a written interview (PAPI). The study participants or their legal guardians were asked to complete this questionnaire at home and then bring it with them to the appointment at the study center. The second part was conducted at the study center, where the interviewer used an age-specific CAPI.[11] Table 2 provides an overview of the topics covered in each questionnaire mode and for each age group.

Non-response survey

A non-response survey was conducted to gain insights into any potential systematic differences between study participants and non-participating target individuals regarding key indicators. Five weeks after the conclusion of the fieldwork, a brief two-page questionnaire was sent to target individuals or their legal guardians who had not responded or had declined to participate (Appendix 1). All questionnaires received by the field institute by 22 January 2024 were included in the non-response analysis. The questionnaire included questions about

various sociodemographic and oral health indicators, such as gender, year of birth, length of residence in Germany, employment status, German citizenship, self-assessment of oral health status, and frequency of dental visits.

A total of 9,644 target individuals were contacted, of whom 1,568 completed and returned the questionnaire. Specifically, 1,114 people mailed back the written paper questionnaire by post, while 454 opted to complete the questionnaire online, resulting in a response rate of 16.3% for the non-response survey. The evaluation revealed no systematic differences between study participants and non-participants, indicating an unbiased data basis (Appendix 2).

Quality assurance

The DMS • 6 data were collected approximately 9 years after the DMS V study. While the current study's approach was based on the framework of previous DMS studies, it was considerably expanded. For instance, the DMS • 6 is significantly more comprehensive due to its new longitudinal component.[4] Furthermore, to ensure a high level of data validity, a multi-stage quality assurance system was implemented both prior to and during fieldwork. This process allowed for evaluations that optimized procedures at each stage of data collection. In addition, it enabled follow-up training sessions for the study personnel.

Pretest

Both DMS • 6 questionnaires, PAPI and CAPI, included new items that had not been included in previous DMS studies. To ensure these items effectively fulfilled their intended purpose, some were tested in a cognitive pretest. Four different pretest techniques were applied across a total of 30 interviews with children, adults, and seniors: retrospectively thinking aloud, behavior coding, cognitive probing, and paraphrasing. These techniques covered a range of topics such as migration history, medical geography, health economics, dental service utilization, oral hygiene behavior, and health status. The topics were discussed semi-qualitatively with pretest participants via video call or in person. The sessions lasted between 30 and 45 minutes. Based on the findings from these interviews, the PAPI and CAPI survey instruments were refined.

Pilot study

Prior to the main study, a pilot study was conducted to test the planned study procedures. This pilot study simulated the main study on a smaller scale, with all primary processes, including data collection, carried out as planned for the main study. This approach allowed for early assessment of timing and procedural optimization. Conducted 6 months before the start of fieldwork, the 1-week pilot study included a total of 20 study participants from various age groups. This setup enabled testing of the entire data pathway—from study participant to dataset—under real-world conditions.

Training, calibration, and reliability testing

Before the start of fieldwork, the DMS • 6 study teams received training from the study group, including the study management, the field institute, and the scientific experts. This training covered the history and procedures of the DMS • 6 study and was delivered through an in-person event and multiple online sessions. Training videos on clinical examinations created by the experts were made available throughout the entire field phase for initial and follow-up training. Theoretical knowledge was assessed with a written examination following the training.

To assess and minimize observer bias, calibration and a reliability test were conducted for the dental personnel by the scientific experts. This included inter- and intra-observer variability assessments for selected dental characteristics (eg, dental status: tooth present/tooth missing; carious tooth surface: yes/no; probing depth in mm). Agreement between study personnel and the scientific experts (gold standard) was evaluated using the intraclass correlation coefficient (ICC) calculated for continuous variables, with Bland-Altman plots provided, and the Cohen kappa coefficient (κ) for categorical variables. Predefined thresholds for passing the reliability test were ICC = 0.5 and κ = 0.6, indicating moderate to good agreement, respectively.[12,13] These thresholds were selected based on the endpoints to be assessed and the conditions of data collection in the field. Personnel who did not meet the quality standards received additional individual follow-up training from the experts, both online and in person. Following the initial reliability test before the field launch, two further reliability tests were conducted during the field phase. Across all tests, inter-individual agreement on dental status between study personnel and the gold standard was good to very good (κ: 0.68 to 1.00), as was intra-individual agreement between two measurements (κ: 0.93 to 1.00). Regarding the gold standard, the intra-individual agreement was κ = 1.00. For probing depths, ICC values for inter-individual agreement ranged from 0.48 to 0.81 and intra-individual agreement from 0.68 to 0.90,

with the gold standard's intra-observer ICC at 0.79. Regarding carious tooth surfaces, ICC values for the study personnel ranged from 0.35 to 0.71 (inter-individual) and from 0.40 to 0.97 (intra-individual), respectively. The intra-observer value of the gold standard was 0.89. Further methodologic details and results are available in Appendix 3.

The principal investigator (ARJ) supervised the study teams during the initial fieldwork week, enabling immediate clarification of issues during on-site training. Alongside the three reliability tests, regular statistical monitoring and analysis of collected data helped identify anomalies and provided a basis for additional training as necessary.

Monitoring

Throughout the entire field period, the field institute and the study management conducted multiple on-site visits with each study team to ensure that the fieldwork processes were implemented as planned. Key aspects were assessed using a standardized checklist. The findings were summarized in a report shared with the DMS • 6 study group. Following data collection, the field institute provided an interim report detailing response rates by age group and gender, along with any notable observations.

In summary, the complexity of the DMS • 6 was managed through comprehensive quality assurance measures, which ensured a high level of data validity.

Disclosure

CO, KK, FZ, and ARJ are employed by the National Association of Statutory Health Insurance Dentists (KZBV). The authors declare that there are no conflicts of interest according to the Uniform Requirements for Manuscripts Submitted to Biomedical Journals. The interpretation of data and presentation of information is not influenced by any personal or financial relationship with any individual or organization.

Author contributions

All authors listed in the paper have contributed sufficiently to fulfill the criteria for authorship according to Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals (ICMJE Recommendations). All authors read and approved the final manuscript. CO is project manager for the DMS • 6 and the author of the manuscript. KK is the deputy principal investigator of the DMS • 6, responsible for the data analysis, and a co-author of the manuscript. FZ is responsible for the social science analysis and a co-author of the manuscript. NFB was deputy principal investigator until October 2023 and is a co-author of the manuscript. CCB was responsible for the organization of the fieldwork and is a co-author of the manuscript. MK was responsible for the data review and preparation as well as the analysis of the current field progress and is a co-author of the manuscript. ARJ is the principal investigator of the DMS • 6, responsible for developing the clinical examinations, and a co-author of the manuscript.

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Appendix 1 to 3

Additional data available at: https://www.idz.institute/publikationen/online-journal-zahnmedizin-forschung-und-versorgung/6th-german-oral-health-study-dms-6-fieldwork-data-collection-and-quality-assurance-online-appendix/.