Cardiovascular diseases and oral health: results of the 6th German Oral Health Study (DMS • 6)

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Objectives: Epidemiologic studies have indicated a correlation between dental and cardiovascular diseases, which remains insufficiently explored. Therefore, this study aimed to compare the prevalence of common dental diseases in younger seniors (65- to 74-year-olds) with and without cardiovascular diseases. **Method and materials:** Participants with available self-reported data on cardiovascular diseases were selected from the cohort of the population-representative 6th German Oral Health Study (DMS • 6), in which caries, periodontitis, and tooth loss were recorded in a standardized manner. The prevalence of oral diseases was compared between participants with and without cardiovascular diseases. **Results:** Compared with participants without cardiovascular diseases, those with cardiovascular diseases had an average of 2.1 fewer teeth, were more frequently edentulous, and were more likely to have advanced periodontal disease (stage IV). In contrast, participants without cardiovascular disease had more fillings (mean + 1.7 teeth) than those with cardiovascular disease. **Conclusion:** The main cause of increased tooth loss — caries or periodontal disease — could not be clarified from the available data. In this study, the prevalence of tooth loss with oral-function limitation was higher in younger seniors with cardiovascular disease.
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Keywords: cardiovascular diseases, cross-sectional studies, dental care, dental caries, dentists, DMS 6, epidemiology, oral health, risk factors

Cardiovascular diseases are mainly associated with periodontal diseases,[1] and evidence regarding their correlation with other oral diseases is limited. The Fifth German Oral Health Study (DMS V)[2] was the first study in Germany to examine the oral health status of younger seniors (65- to 74-year-olds) with severe disabilities (≥ 50%). The study revealed a higher incidence of caries in the target group than in the control group. However, differences in periodontal health were less distinct. On average, younger seniors with severe disability had 3.8 fewer functional teeth, and complete edentulism was almost twice as frequent as in the entire age group (22.7% vs 12.4%). However, the diseases underlying severe disabilities were diverse. Thus, the analysis could not identify associations with socially significant chronic diseases.

Therefore, the 6th German Oral Health Study (DMS • 6) aimed to examine the correlation between epidemiologically significant dental diseases (caries, periodontitis, and tooth loss) and cardiovascular diseases in younger seniors (65- to 74-year-olds).

Method and materials

The general methodology of the study is presented in separate articles.[3,4] The DMS • 6 was approved by the Institutional Review Board (IRB) of the Witten/Herdecke University, Witten, Germany (registration number S-249/2021). The study was registered at the German Clinical Trials Register (registration number DRKS00028701).

Sample

For the data analysis, participants aged 65 to 74 years with available self-reported data on cardiovascular diseases were

selected from those who met the inclusion criteria for the DMS • 6 analysis set. In total, data from 791 younger seniors were included in the analysis; six individuals were excluded because of missing information.

Variables

Cardiovascular disease

Medically diagnosed cardiovascular diseases (self-reported) were recorded as part of the social science survey. Cardiovascular disease was defined as the presence of at least one of the following diagnoses:

- myocardial infarction
- coronary heart disease or angina pectoris
- cardiac insufficiency
- cardiac arrhythmias
- intermittent claudication or peripheral vascular disease
- stroke.

Dental endpoints

The following variables recorded during the clinical examination were selected for the analysis of the research questions:

- caries experience (decayed, missing, filled teeth [DMFT]) and prevalence of root caries[5]
- number of filled or sound teeth (FST index), tooth loss, and edentulism[5]
- degree of restoration of coronal caries (%)[5]
- plaque accumulation (modified Marginal Plaque Index [mMPI])[6]
- gingivitis and periodontal findings (bleeding on probing [BOP]; European Federation of Periodontology/American Academy of Periodontology [EFP/AAP] classification).[7]

Social characteristics

Data regarding the following general social characteristics were collected:

- sociodemographic factors (eg, age, gender, and education status)
- medical history and physiological characteristics (eg, body mass index and diabetes mellitus)
- smoking status
- self-assessment of oral health status
- oral hygiene behavior (eg, tooth brushing frequency and interdental cleaning frequency)
- dental service utilization (eg, dental visits and professional tooth cleaning).

Statistical analysis

Participants were divided into two groups based on the presence of cardiovascular disease. Regarding the epidemiologic description of oral diseases, prevalence rates or means were calculated with corresponding 95% confidence intervals (CIs). A weighted dataset was used to compensate for differing probabilities in the selection of study participants and differences in terms of gender, age, and region compared with the overall population in Germany. Descriptive analyses of sociodemographic variables used to characterize the study participants were not weighted. Numbers (n) are provided without weighting. Detailed information on data handling and statistical methods is described previously.[8]

Results

The participants' characteristics are presented in Table 1. Overall, 27.6% of the participants had self-reported cardiovascular disease (Table 2).

Systematic differences in social and general medical variables were observed between the groups with and without cardiovascular diseases (Table 1). Participants with cardiovascular diseases were slightly older and more frequently male. Moreover, the average education status was lower than that of participants without cardiovascular diseases. In addition, the mean body mass index was different between the groups; more participants with cardiovascular diseases were obese (body mass index ≥ 30 kg/m^2). Other social characteristics were not significantly different between the groups (Table 1).

General dental health profile

Younger seniors with cardiovascular diseases had a lower mean number of teeth (−2.1 teeth) and were edentulous more often than participants without cardiovascular diseases (7.4% vs 4.2%). No differences were observed in plaque accumulation (mMPI) or gingival bleeding (BOP) (Table 3).

Periodontal health profile

Comparative analyses of periodontal parameters, such as the mean periodontal probing depth and clinical attachment level, revealed no significant differences between the two groups (Table 3). However, the prevalence of severe periodontal disease (stage IV) tended to be higher in participants with cardiovascular diseases than in those without (29.0% vs 25.5%; Table 4).

Table 1 Baseline characteristics of study participants for younger seniors (65- to 74-year-olds) by cardiovascular disease

Variable		Cardiovascular disease	
		Yes	No
No. of participants (n)		216	575
Age, years		70.4 ± 2.6	69.5 ± 2.8
Gender	Male	123 (56.9%)	248 (43.1%)
	Female	93 (43.1%)	327 (56.9%)
Education group	Low	51 (24.9%)	107 (19.5%)
	Medium	98 (47.8%)	269 (48.9%)
	High	56 (27.3%)	174 (31.6%)
Monthly net equivalent income, Euro		1,901 ± 924	2,031 ± 1,081
Migration history	People with migration history	34 (16.7%)	71 (12.9%)
	People without migration history	170 (83.3%)	478 (87.1%)
Smoking status	Never smoked	92 (42.6%)	288 (50.1%)
	Former smoker	95 (44.0%)	203 (35.3%)
	Current smoker	29 (13.4%)	84 (14.6%)
Body mass index, kg/m^2		28.5 ± 5.0	26.9 ± 4.9
	< 25	46 (22.7%)	196 (36.1%)
	25 – < 30	88 (43.3%)	223 (41.1%)
	≥ 30	69 (34.0%)	124 (22.8%)
Diabetes mellitus (self-reported)	No or gestational diabetes	174 (80.6%)	490 (85.5%)
	Type 1 diabetes	0 (0.0%)	1 (0.2%)
	Type 2 diabetes	42 (19.4%)	82 (14.3%)
Self-assessment of oral health status	Very good / good	129 (60.0%)	375 (65.2%)
	Moderate / poor / very poor	86 (40.0%)	200 (34.8%)
Tooth brushing (frequency)	≥ 2 times daily	162 (82.2%)	456 (83.8%)
	< 2 times daily	35 (17.8%)	88 (16.2%)
Interdental cleaning (frequency)	≥ once daily	63 (32.0%)	219 (40.3%)
	< once daily	134 (68.0%)	325 (59.7%)
Dental visits (frequency)	≥ once a year	182 (85.4%)	506 (88.5%)
	< once a year	31 (14.6%)	66 (11.5%)
Dental service utilization	Complaint-oriented	34 (15.7%)	69 (12.0%)
	Control-oriented	182 (84.3%)	505 (88.0%)
Professional tooth cleaning (utilization)	Yes	153 (72.2%)	465 (81.0%)
	No	58 (27.4%)	107 (18.6%)
	Don't know	1 (0.5%)	2 (0.3%)
Professional tooth cleaning (frequency)	Never	58 (28.7%)	107 (19.5%)
	< once a year	36 (17.8%)	134 (24.4%)
	≥ once a year	108 (53.5%)	308 (56.1%)
Lifetime periodontal treatment (utilization)	Yes	71 (33.3%)	183 (31.8%)
	No	133 (62.4%)	370 (64.3%)
	Don't know	9 (4.2%)	22 (3.8%)

Data are presented as numbers (percentages) or mean ± standard deviation based on unweighted data. Cardiovascular diseases (≥ 1; self-reports): myocardial infarction, angina pectoris, cardiac insufficiency, cardiac arrhythmias, intermittent claudication, stroke.

Caries and oral health care related health profile

Caries experience (DMFT) was not significantly different between the two groups. However, stratification of the composite index of DMFT yielded differences. Participants without cardiovascular disease had more fillings (+ 1.7 teeth) than those with cardiovascular disease. The proportion of untreated carious teeth was comparable between the groups. Owing to the higher proportion of fillings among participants without cardiovascular diseases, a difference was observed in the FST index between the groups with and without cardiovascular disease (17.3 teeth vs 19.4 teeth). Additionally, there was a statistical difference in the prevalence of root caries between the groups with and without cardiovascular disease (52.5 % vs 61.2 %). These results align with the teeth-at-risk concept, which suggests that increased tooth retention increases the risk of root caries and periodontitis (Table 3).

Oral health status and oral hygiene behavior

Overall, participants with cardiovascular disease assessed their own oral health status as less favorable. Annual dental visits were less frequent and more complaint-oriented in this group. Moreover, interdental and professional tooth cleaning were reported less frequently. However, participants with cardiovascular disease were more likely to have undergone lifetime periodontal treatment (Table 1).

Discussion

A comparative evaluation of key dental health parameters between younger seniors (65- to 74-year-olds) with and without cardiovascular diseases showed that individuals with cardiovascular disease had approximately two fewer teeth, and the number of healthy functional teeth was smaller. Moreover, younger seniors with cardiovascular disease more frequently tended to be edentulous and exhibited a higher prevalence of severe periodontal disease (stage IV).

A previous study reported a higher risk of cardiovascular disease in patients with periodontitis. Moreover, the risk of the first coronary event was higher in individuals with severe periodontitis than in those with mild or no periodontitis. Furthermore, correlations between periodontal diseases and cerebrovascular disease and stroke were observed; however, these associations were not observed in seniors (age > 65 years).[9] In addition, a meta-analysis reported a correlation between periodontitis and arteriosclerotic diseases,[10] and a national health survey in Taiwan reported an association between atrial fibrillation and periodontitis.[11]

Table 2 Prevalence of cardiovascular diseases among younger seniors (65- to 74-year-olds)

Variable	65- to 74-year-olds
No. of participants (n)	791
Cardiovascular disease (prevalence)	27.6% (24.6; 30.8)
Myocardial infarction	6.2% (4.6; 7.9)
Angina pectoris	6.7% (5.1; 8.6)
Cardiac insufficiency	6.7% (5.1; 8.6)
Cardiac arrhythmias	14.3% (11.9; 16.8)
Intermittent claudication	4.4% (3.1; 6.0)
Stroke	4.2% (3.0; 5.8)

Data are presented as unweighted numbers (n) and weighted percentages (with 95% confidence intervals).

Nonetheless, transdisciplinary caries research links cardiovascular diseases to dietary habits and follows the "common risk factor approach."[5] The focus is on low-molecular-weight carbohydrate intake and diabetes and its relationship with overweight or obesity.[12]

Inflammation may be a possible causal explanation for the association between dental and cardiovascular diseases.[13] Insufficient oral hygiene is the main cause of periodontitis and is associated with systemic inflammatory reactions and elevated concentrations of C-reactive protein and other inflammatory biomarkers.[14] Several studies have reported a correlation between tooth brushing and cardiovascular diseases.[14-16] In the DMS • 6, extensive video recordings were made; however, analyses of the videos are not expected to be available until 2026.

Existing evidence suggests that among dental diseases, periodontal diseases are mainly correlated with cardiovascular diseases.[9] In the present study, the prevalence of severe periodontal disease tended to be higher in the group with cardiovascular diseases; however, other periodontal parameters were not significantly different between the groups. Therefore, the results of previous studies could not be confirmed. This could be attributed to the differing definitions and survey methods used for cardiovascular diseases. Nonetheless, regarding the final endpoint of periodontal disease, that is tooth loss, the results were clearly in line with those of previous studies.

Tooth loss appears to be a definitive indicator of poor oral health among younger seniors with cardiovascular diseases. Tooth loss is associated with cardiac health, periodontal markers, and oral function. The extent to which the two main oral diseases, caries and periodontitis, and particularly which of the two, seem to be the primary cause increased tooth loss, could

Table 3 Epidemiologic estimates and self-reported treatment of oral diseases in younger seniors (65- to 74-year-olds) by cardiovascular disease

Variable	Cardiovascular disease	
	Yes	No
No. of teeth (n)	17.7 (16.5; 18.9)	19.8 (19.2; 20.5)
Edentulism (prevalence)	7.4% (4.4; 11.4)	4.2% (2.8; 6.1)
DMFT	17.9 (17.1; 18.8)	17.6 (17.2; 18.0)
DT	0.4 (0.3; 0.5)	0.4 (0.3; 0.5)
MT	10.1 (8.9; 11.4)	8.0 (7.4; 8.7)
FT	7.4 (6.7; 8.2)	9.1 (8.7; 9.6)
FST	17.3 (16.1; 18.5)	19.4 (18.7; 20.0)
ST	9.9 (9.1; 10.7)	10.2 (9.8; 10.6)
Degree of restoration of coronal caries (%)	90.7 (87.3; 94.0)	94.2 (92.8; 95.7)
Root caries (prevalence)	52.5% (45.7; 58.9)	61.2% (57.3; 65.2)
mMPI (% segments with plaque)	45.6 (41.3; 49.9)	43.6 (41.3; 45.0)
BOP (% sites)	21.1 (17.8; 24.4)	20.0 (18.2; 21.7)
Mean PD, mm	2.7 (2.6; 2.8)	2.6 (2.5; 2.7)
Mean CAL, mm	2.5 (2.3; 2.8)	2.3 (2.2; 2.5)
CAL ≥ 3 mm (prevalence)	97.6% (94.8; 99.4)	95.0% (92.8; 96.6)

Data are presented as weighted percentages or weighted means (with 95% confidence intervals).
BOP, bleeding on probing; CAL, clinical attachment level; DMFT, decayed, missing, filled teeth; DT, decayed teeth; FST, filled or sound teeth; FT, filled teeth; mMPI, modified Marginal Plaque Index; MT, missing teeth; PD, probing depth; ST, sound teeth.
Cardiovascular diseases (≥ 1; self-reports): myocardial infarction, angina pectoris, cardiac insufficiency, cardiac arrhythmias, intermittent claudication, stroke.

Table 4 Categorization according to the 2018 EFP/AAP periodontitis classification in younger seniors (65- to 74-year-olds) by cardiovascular disease

Variable		Cardiovascular disease	
		Yes	No
No. of participants (n)		189	577
Periodontitis cases	All stages	78.0% (58.7; 100.0)	87.6% (74.9; 100.0)
	Stage I	5.9% (3.1; 9.8)	9.2% (7.1; 12.0)
	Stage II	23.1% (17.7; 29.7)	24.6% (21.2; 28.3)
	Stage III	20.0% (14.9; 26.2)	28.1% (24.6; 32.0)
	Stage IV	29.0% (23.0; 35.9)	25.5% (22.0; 29.2)
Edentulous		8.5% (5.1; 13.1)	4.3% (2.9; 6.2)
Non-classified*		13.5% (9.4; 19.2)	8.1% (6.0; 10.6)

Data are presented as unweighted numbers (n) and weighted percentages (with 95% confidence intervals) for edentate and dentate participants with complete periodontal findings.
*Periodontitis case definition not applicable.
EFP/AAP, European Federation of Periodontology/American Academy of Periodontology.
Cardiovascular diseases (≥1; self-disclosures): myocardial infarction, angina pectoris, cardiac insufficiency, cardiac arrhythmias, intermittent claudication, stroke.

not be determined from this cross-sectional analysis. However, in individuals aged > 40 years tooth loss is mainly caused by periodontal disease.[17] Thus, the oral health differences in this study could be attributed mainly to periodontal diseases.

Future longitudinal studies should investigate this using long-term study cycles (life-span studies) because tooth loss is, if not the result of trauma, the end stage of long-term oral diseases with various etiologies. The longitudinal component of

DMS • 6, with a re-survey and re-analysis of the study participants from DMS V of 2014, aims to investigate this topic.

One strength of this study is that the examined participants were surveyed as part of a population-representative study. Therefore, selection bias owing to regional differences or other distorting effects was less likely. The results from other population studies that reported the prevalence of cardiovascular diseases are consistent with the present findings.[18-21] The results largely correspond with current data (prevalence of cardiovascular diseases in younger seniors, 27.6%). A limitation of the present study is that because the information regarding underlying diseases was self-reported provided by the participants, it does not represent a reliable medical diagnosis. In contrast, dental diagnoses as part of the DMS • 6 were made exclusively by the dental practitioners conducting the study. Nonetheless, cross-sectional epidemiologic studies do not allow for conclusive evaluations, but can merely identify statistical associations. Therefore, this evaluation has hypothesis-generating characteristics.

Conclusion

Despite advances in dental care and efforts to collaborate with other disciplines, awareness regarding the correlation between oral health and cardiovascular diseases is lacking, especially among at-risk groups susceptible to systemic inflammation, such as individuals with diabetes or hypertension.[22] Considering the increasing insights into oral health and its impact on cardiovascular diseases, greater awareness of this relationship among general practitioners and cardiologists is urgently required to improve education and dental referrals to prevent cardiovascular diseases.[23]

Disclosure

ARJ, KK, and DS 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. ARJ is the principal investigator of the DMS • 6, responsible for developing the clinical examinations, and the author of the manuscript. DS is jointly responsible for the statistical data processing and analysis. KK is the deputy principal investigator of the DMS • 6, responsible for the data analysis, and a co-author of the manuscript. WR is a member of the extended scientific advisory board of the DMS • 6 and a co-author of the manuscript.

References

1. Sanz M, Del Marco Castillo A, Jepsen S, et al. Periodontitis and cardiovascular diseases: Consensus report. J Clin Periodontol 2020;47:268–288.
2. Jordan AR, Micheelis W (eds). Fünfte Deutsche Mundgesundheitsstudie (DMS V). Cologne: Deutscher Zahnärzte Verl., 2016.
3. Jordan AR, Frenzel Baudisch N, Ohm C, et al. 6th German Oral Health Study (DMS • 6): rationale, study design, and baseline characteristics. Quintessence Int 2025;56(Suppl): S4–S12.
4. Ohm C, Kuhr K, Zimmermann F, et al. 6th German Oral Health Study (DMS • 6): fieldwork, data collection, and quality assurance. Quintessence Int 2025;56(Suppl):S14–S21.
5. Jordan AR, Meyer-Lückel H, Kuhr K, Sasunna D, Bekes K, Schiffner U. Caries experience and care in Germany: results of the 6th German Oral Health Study (DMS • 6). Quintessence Int 2025;56(Suppl):S30–S39.
6. Deinzer R, Jordan AR, Kuhr K, Margraf-Stiksrud J. Oral hygiene behavior and toothbrushing skills: results of the 6th German Oral Health Study (DMS • 6). Quintessence Int 2025;56(Suppl):S82–S87.
7. Eickholz P, Holtfreter B, Kuhr K, Dannewitz B, Jordan AR, Kocher T. Prevalence of the periodontal status in Germany: results of the 6th German Oral Health Study (DMS • 6). Quintessence Int 2025;56(Suppl):S40–S47.
8. Kuhr K, Sasunna D, Frenzel Baudisch N, et al. 6th German Oral Health Study (DMS • 6): data processing and statistical methods. Quintessence Int 2025;56(Suppl):S22–S29.
9. Dietrich T, Sharma P, Walter C, Weston P, Beck J. The epidemiological evidence behind the association between periodontitis and incident atherosclerotic cardiovascular disease. J Periodontol 2013;84(4 Suppl): S70–S84.
10. Yang S, Zhao LS, Cai C, Shi Q, Wen N, Xu J. Association between periodontitis and peripheral artery disease: a systematic review and meta-analysis. BMC Cardiovasc Disord 2018;18:141.
11. Chen D-Y, Lin C-H, Chen Y-M, Chen H-H. Risk of atrial fibrillation or flutter associated with periodontitis: a nationwide, population-based, cohort study. PLoS One 2016; 11:e0165601.
12. Huysmans MC, Fontana M, Lussi A, et al. European Organisation for Caries Research and the European Federation of Conservative Dentistry Consensus Report on Clinical Recommendations for Caries Diagnosis: Paper III - Caries Diagnosis at the Individual Level. Caries Res 2024;58:521–532.
13. Hopkins S, Gajagowni S, Qadeer Y, et al. Oral health and cardiovascular disease. Am J Med 2024;137:304–307.

14. Oliveira C de, Watt R, Hamer M. Toothbrushing, inflammation, and risk of cardiovascular disease: results from Scottish Health Survey. Br Med J 2010;340:c2451.

15. Isomura ET, Suna S, Kurakami H, et al. Not brushing teeth at night may increase the risk of cardiovascular disease. Sci Rep 2023;13:10467.

16. Moon M-G, Kang S-H, Kim S-H, et al. Association between toothbrushing and cardiovascular risk factors: a cross-sectional study using Korean National Health and Nutrition Examination Survey 2015–2017. BMC Oral Health 2024;24:4.

17. Micheelis W, Jordan AR. Zeitliche Dynamik der Zahnverluste in Deutschland. In: Jordan AR, Micheelis W (eds). Fünfte Deutsche Mundgesundheitsstudie (DMS V). Cologne: Deutscher Zahnärzte Verl., 2016:591–594.

18. Busch MA, Kuhnert R. 12-Month prevalence of coronary heart disease in Germany. J Health Monit 2017;2:58–63.

19. Störk S, Handrock R, Jacob J, et al. Epidemiology of heart failure in Germany: a retrospective database study. Clin Res Cardiol 2017;106:913–922.

20. Schnabel RB, Wilde S, Wild PS, Munzel T, Blankenberg S. Atrial fibrillation: its prevalence and risk factor profile in the German general population. Dtsch Arztebl Int 2012; 109:293–299.

21. Busch MA, Schienkiewitz A, Nowossadeck E, Gößwald A. Prävalenz des Schlaganfalls bei Erwachsenen im Alter von 40 bis 79 Jahren in Deutschland: Ergebnisse der Studie zur Gesundheit Erwachsener in Deutschland (DEGS1). Bundesgesundheitsbl 2013;56:656–660.

22. Usmani W, Courten M de, Hanna F. Can oral health care be a gateway to improve cardiovascular disease? A scoping review. Front Oral Health 2024;5:1364765.

23. Gianos E, Jackson EA, Tejpal A, et al. Oral health and atherosclerotic cardiovascular disease: a review. Am J Prev Cardiol 2021; 7:100179.

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