

# Evaluating changes in dental status among Polish older adults over a decade: A comparative analysis of PolSenior (2009) and PolSenior2 (2019) surveys

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Dental and Medical Problems, ISSN 1644-387X (print), ISSN 2300-9020 (online)

*Dent Med Probl.* 2025;62(1):23–30

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## Funding sources

None declared

## Conflict of interest

None declared

## Acknowledgements

None declared

Received on October 5, 2024

Reviewed on October 21, 2024

Accepted on November 27, 2024

Published online on February 18, 2025

## Cite as

Dąbrowski W, Jagiełło K, Mossakowska M, et al. Evaluating changes in dental status among Polish older adults over a decade: A comparative analysis of PolSenior (2009) and PolSenior2 (2019) surveys. *Dent Med Probl.* 2025;62(1):23–30. doi:10.17219/dmp/196535

## DOI

10.17219/dmp/196535

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## Abstract

**Background.** The aging global population poses new challenges to healthcare systems, including dental healthcare. This study analyzes the evolution of dental status within the aging population of Poland over the last pre-pandemic decade.

**Objectives.** The goal of the study was to examine changes in dental health among Poland's aging population, with a specific focus on edentulism, partial tooth loss and functional dentition. Furthermore, the study aimed to evaluate the influence of sociodemographic factors on oral health, assess the effectiveness of public health initiatives, and identify persistent inequities in oral health.

**Material and methods.** The study utilized data from 2 representative population-based studies: the PolSenior (PS) (2008–2009); and the PolSenior2 (PS2) (2018–2019). The comparative analysis involved 4,773 (PS) and 4,627 (PS2) Polish adults aged more than 65 years. The participants were categorized based on the number of teeth present (0 – edentulism, 1–19 – partial tooth loss,  $\geq 20$  – functional dentition) and analyzed for various factors, including age, sex, education level, and place of residence.

**Results.** The dental status of Polish older adults has improved over the past decade, with the prevalence of edentulism decreasing from 45.8% to 36.1%, and the proportion of individuals with functional dentition increasing from 6.0% to 15.0%. The prevalence of edentulism dropped from 49.4% to 40.5% among women and from 40.3% to 29.3% among men, while functional dentition increased 2.5-fold in both sexes. The most significant improvements were observed among the youngest seniors, with a reduction in edentulism and an increase in functional dentition.

**Conclusions.** The findings of this study indicate a notable improvement in dental status of Polish older adults, as evidenced by a decline in the prevalence of edentulism and an increase in functional dentition. The research underscores the persistent disparities related to basic needs in relation to sociodemographic factors in dental treatment.

**Keywords:** geriatric dentistry, dental health, older adult population, edentulous mouth, demographic trends

## Highlights

- The prevalence of edentulism among Polish older adults decreased significantly from 45.8% in 2009 to 36.1% in 2019.
- Lower education levels, rural residency and female sex are associated with higher rates of edentulism.
- Continued investment in preventive programs, improved access to dental care in rural areas, and education on oral health are essential to reduce disparities among older adults in Poland.

## Introduction

The global demographic landscape is undergoing a significant transformation, characterized by an increasing proportion of older adults. This shift, evident not only in developed countries but also in emerging economies, carries profound implications for healthcare systems globally. The increase in lifespan is leading to demographic transformations that are likely to be among the most impactful social changes of our century. As reported by the United Nations (UN), the global population of individuals aged 65 and older was 727,000,000 in 2020, representing 9.3% of the world's population. This figure is projected to rise to 16% by the year 2050. A similar aging trend has been observed in the European Union (EU). From 1960, when only 9.6% of the EU population was over 65, the percentage rose to 20.3% by 2019 and is expected to reach 31.3% by the end of the century.<sup>1,2</sup> As reported by the Polish Central Statistical Office on December 31, 2022, 22.9% of the Polish population was of post-working age (over 60 years of age), compared to 16.8% in 2010.<sup>3</sup>

The older adult population is predisposed to various systemic ailments, including oral diseases that can substantially affect their quality of life. Common issues, such as difficulties with chewing, swallowing and speaking, exacerbate the challenges faced by this age group.<sup>4,5</sup> Notably, tooth loss in older adults is often linked to prevalent conditions like caries and periodontal disease.<sup>6,7</sup> Periodontitis has a significant influence on the quality of life of affected individuals, emphasizing the need for preventive dental care to improve overall well-being and reduce the burden of oral diseases.<sup>8</sup> Moreover, there is a widespread belief that oral health tends to decline with age. Additionally, research indicates that poor oral health may increase vulnerability to systemic diseases and exacerbate complications associated with coronavirus disease 2019 (COVID-19).<sup>9,10</sup>

Edentulism (toothlessness) is a common disability that has an influence on general health, including functional abilities as well as self-esteem and social interactions.<sup>11</sup> It is also associated with an increased risk of malnutrition, cardiovascular diseases, gastrointestinal disorders, and sleep apnea.<sup>12–14</sup> The global prevalence of edentulism in individuals aged 45 and above was 22% worldwide and 28% in Europe.<sup>15</sup> Therefore, identifying covariates

of tooth loss is essential for the development of effective preventive strategies.

While preventive programs typically focus on children and adolescents, gerostomatology, the study of oral health in older adults, is still developing. However, its significance is expected to grow with the aging population and the increasing life expectancy. A range of classifications are utilized to systematize the clinical presentations of tooth loss, including topographic, quantitative and occlusal morphological categories, supporting both diagnostic and therapeutic analyses.<sup>16</sup> In broader health studies where dental aspects are not the primary focus, the World Health Organization (WHO) classifications based solely on the number of teeth present in the oral cavity are commonly used. These classifications provide a simplified assessment of the oral health status.

The PolSenior (PS) and PolSenior2 (PS2) studies aimed to assess the current health and socioeconomic status of the Polish elderly population, with a particular focus on the oldest cohorts.<sup>17,18</sup> The goal of this substudy was to conduct a comprehensive comparative analysis of dental health status of Polish seniors and to identify shifts in the oral health trends over the past decade.

## Material and methods

The PS project, a cross-sectional study conducted from 2008 to 2009, involved a representative group of 4,979 Polish adults aged 65 and above. Recognized as a pivotal project for monitoring the health of Polish seniors, it included the assessment of dental status, as well as prevalence and utilization of dentures.<sup>18</sup> A decade later, in 2018–2019, this survey was replicated under the PS2 study with 5,987 newly selected participants, including adults aged 60 and above. Both studies recruited participants from every administrative region in Poland, forming cohorts in 5-year age bands. These cohorts, which were comparable in size, maintained a balance between female and male participants.

The sampling method for both the PS and PS2 studies was based on a three-stage stratified and proportional random sampling design, ensuring representation from all regions of Poland. In the first stage, local administrative units (urban, rural and urban-rural municipalities) were selected arbitrarily. Next, within these units, specific

streets or villages were randomly drawn. Finally, individual participants were selected using the PESEL (Universal Electronic System for Registration of the Population) registry, a comprehensive database managed by the Ministry of the Interior and Administration of Poland, which ensures accurate representation of the population across different regions. In both studies, oversampling was applied to ensure a sufficient number of participants in older age groups, allowing for a detailed statistical analysis across all age cohorts.<sup>17,18</sup>

The present study undertakes an analysis of the corresponding groups from both studies, encompassing 4,773 individuals aged  $\geq 65$  from PS and 4,627 participants of a similar age from PS2.

The participants were categorized into 3 groups based on the number of teeth present: toothless individuals; those with partial tooth loss (1–19 teeth); and those with functional dentition ( $\geq 20$  teeth). The analysis considered various factors, including age groups (65–74, 75–84 and  $\geq 85$  years), sex, place of residence, and education level: primary (primary or incomplete primary); vocational; secondary (high school or post-secondary school); and higher.

## Statistical analysis

The analysis involved a comparative evaluation of data from both surveys. Descriptive statistics were employed to summarize the findings. Comparative analyses, including the  $\chi^2$  test for categorical variables, were conducted to discern significant differences in dental status between the 2 time points. Age standardization was applied to adjust for demographic changes over the decade.

The statistical analyses were performed with the use of R v. 3.6.3 (R Core Team; <https://cran.mi2.ai>) and SAS<sup>®</sup> 9.4 TS1M5 (SAS Institute, Inc., Cary, USA). The data was presented as percentages and 95% confidence intervals (95% CIs). Sampling weights were included in the statistical calculations to account for the complex survey design, using the R survey package. The post-stratification procedure was used to match the age–sex sample distribution to the population of Poland in 2019. The level of statistical significance was set at  $p < 0.05$ .

## Ethical considerations

Both the PS and PS2 surveys adhered to ethical guidelines throughout their execution. Moreover, written

informed consent to participate in these studies was provided by the participants. The studies were conducted in accordance with the local legislation and institutional requirements and were approved by the Independent Bioethics Commission (NKBBN/257/2017).<sup>17,18</sup>

## Results

A comparative analysis of the PS (2009) and PS2 (2019) studies revealed a significant change in dental status of the Polish population aged  $\geq 65$  years (Fig. 1). The prevalence of edentulism decreased from 45.8% (CI: 42.3–49.3) to 36.1% (CI: 33.6–38.6), while the proportion of individuals with functional dentition increased from 6.0% (CI: 4.6–7.5) to 15.0% (CI: 12.8–17.2).

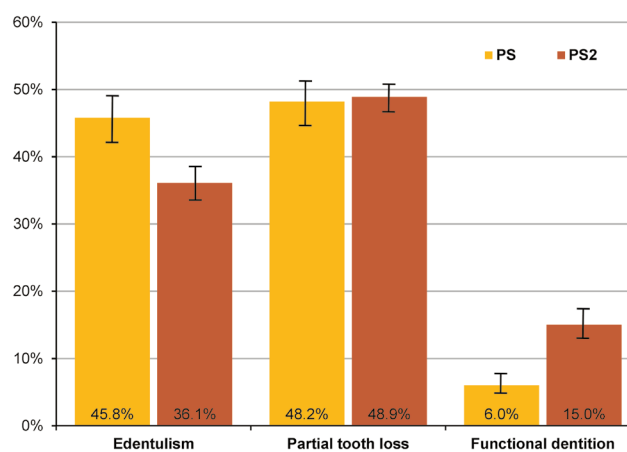


Fig. 1. Prevalence of edentulism, partial tooth loss and functional dentition in the PolSenior (PS) and PolSenior2 (PS2) population

## Demographic perspective

### Differences in sex

In women, the prevalence of edentulism decreased from 49.4% to 40.5%, with an increase in functional dentition from 4.9% to 12.5% between the PS and PS2 studies (Table 1). A more pronounced improvement has been observed in the male population, where edentulism rates decreased from 40.3% to 29.3%, and the proportion of individuals with functional dentition increased from 7.8% to 19.0%. In the group of respondents with partial tooth

Table 1. Prevalence of edentulism, partial tooth loss and functional dentition among the population of Polish older adults in the Polsenior (PS) ( $n = 4,773$ ) and Polsenior 2 (PS2) ( $n = 4,627$ ) studies

| Variable | Edentulism |                   | Partial tooth loss |                  | Functional dentition |                 |                   |
|----------|------------|-------------------|--------------------|------------------|----------------------|-----------------|-------------------|
|          | PS         | PS2               | PS                 | PS2              | PS                   | PS2             |                   |
| Sex      | female     | 49.4 (45.5–53.4)  | 40.5 (37.3–43.6)   | 45.7 (41.8–49.6) | 47.1 (44.2–50.0)     | 4.9 (3.1–6.7)*  | 12.5 (9.9–15.0)*  |
|          | male       | 40.3 (34.0–46.5)* | 29.3 (26.4–32.2)*  | 52.0 (46.7–57.3) | 51.7 (48.5–54.9)     | 7.8 (5.5–10.0)* | 19.0 (15.6–22.4)* |

\* statistically significant difference between PS and PS2 ( $p < 0.05$ ,  $\chi^2$  test). Data presented as percentage (%) (95% confidence interval (CI)).

loss, no significant changes were observed among both women and men between the 2 studies. In the original PS study, the differences in the prevalence of edentulism and functional dentition between women and men were not statistically significant. However, a decade later, a marked improvement in dental health was observed among men compared to women, as evidenced by lower rates of edentulism and higher rates of functional dentition (Table 1).

### Age stratification trends

The prevalence of edentulism increased with age in both studies, reaching a peak of 67.3% in females and 54.7% in males in 2009, and 69.4% in females and 55.5% in males in 2019 among individuals over 85 years of age. The findings of both studies demonstrated an inverse relationship between functional dentition and age (Table 2 and Table 3).

In the 65–74 age group, the prevalence of edentulism exhibited a significant decline among women, from 40.8% in PS to 28.8% in PS2, and among men, from 36.8% to 21.1%, respectively. In parallel, an increase in functional dentition was observed, from 7.4% to 18.4% among women and from 9.3% to 24.4% among men.

In the 75–84 age cohort, a significant change was observed only in women with functional teeth: 2.2% in PS compared to 6.8% in PS2. No alterations in dental status were identified in the oldest analyzed group.

The difference in the prevalence of edentulism between men and women was not observed in the youngest analyzed cohort (65–74 years) in both studies. In PS, edentulism was more prevalent in women aged 75–84 years than in men, while 10 years later, the difference between sexes was statistically significant only in the oldest group ( $\geq 85$  years).

**Table 2.** Prevalence of edentulism, partial tooth loss and functional dentition among the population of Polish elderly women in the Polsenior (PS) ( $n = 2,314$ ) and Polsenior 2 (PS2) ( $n = 2,371$ ) studies, categorized by age, education level and place of residence

| Variable           | Edentulism                      |                   | Partial tooth loss |                   | Functional dentition |                  |                   |
|--------------------|---------------------------------|-------------------|--------------------|-------------------|----------------------|------------------|-------------------|
|                    | PS                              | PS2               | PS                 | PS2               | PS                   | PS2              |                   |
| Age [years]        | 65–74                           | 40.8 (35.0–46.7)* | 28.8 (24.9–32.6)*  | 51.8 (45.7–57.9)  | 52.8 (48.2–57.4)     | 7.4 (4.6–10.2)*  | 18.4 (14.6–22.3)* |
|                    | 75–84                           | 57.0 (51.3–62.7)  | 47.8 (42.6–53.0)   | 40.8 (35.2–46.3)  | 45.4 (40.7–50.1)     | 2.2 (0.9–3.6)*   | 6.8 (4.6–9.0)*    |
|                    | $\geq 85$                       | 67.3 (60.3–74.3)  | 69.4 (64.4–74.3)   | 31.9 (25.0–38.9)  | 28.8 (23.8–33.7)     | 0.8 (0.0–1.7)    | 1.8 (0.9–2.8)     |
| Education level    | primary                         | 58.5 (52.9–64.1)  | 56.9 (52.7–61.2)   | 40.2 (34.5–45.9)  | 40.8 (36.5–45.2)     | 1.3 (0.5–2.0)    | 2.2 (1.2–3.2)     |
|                    | vocational                      | 40.4 (31.3–49.5)  | 37.9 (31.1–44.6)   | 52.9 (43.0–62.7)  | 52.5 (45.0–60.1)     | 6.7 (0.6–12.9)   | 9.6 (5.6–13.6)    |
|                    | secondary                       | 39.0 (32.4–45.6)  | 31.2 (26.8–35.6)   | 52.1 (43.5–60.6)  | 52.0 (47.4–56.6)     | 8.9 (4.1–13.7)   | 16.8 (13.5–20.1)  |
|                    | higher                          | 16.4 (9.0–23.9)   | 18 (11.8–24.2)     | 63.7 (54.3–73.0)* | 47.1 (40.4–53.8)*    | 19.9 (11.5–28.2) | 34.9 (27.0–42.8)  |
| Place of residence | rural area                      | 56.9 (49.7–64.1)  | 50.7 (46.3–55.0)   | 42.2 (35.0–49.5)  | 44.0 (39.3–48.8)     | 0.9 (0.2–1.5)*   | 5.3 (2.9–7.7)*    |
|                    | city (<50,000 residents)        | 48.2 (42.0–54.5)  | 38.3 (33.9–42.6)   | 46.4 (40.3–52.6)  | 49.9 (44.8–55.1)     | 5.3 (2.6–8.1)*   | 11.8 (8.5–15.1)*  |
|                    | city (50,000–200,000 residents) | 51.3 (43.0–59.6)  | 36.4 (28.2–44.5)   | 43.2 (35.1–51.4)  | 49.2 (41.1–57.3)     | 5.5 (2.3–8.6)*   | 14.4 (9.0–19.8)*  |
|                    | city (>200,000 residents)       | 34.5 (28.2–40.9)  | 26.7 (21.2–32.3)   | 53.6 (45.1–62.1)  | 48.0 (41.1–54.8)     | 11.9 (6.9–16.9)* | 25.3 (20.7–29.9)* |

\* statistically significant difference between PS and PS2 ( $p < 0.05$ ,  $\chi^2$  test). Data presented as % (CI).

**Table 3.** Prevalence of edentulism, partial tooth loss and functional dentition among the population of Polish elderly men in the Polsenior (PS) ( $n = 2,459$ ) and Polsenior 2 (PS2) ( $n = 2,256$ ) studies, categorized by age, education level and place of residence

| Variable           | Edentulism                      |                   | Partial tooth loss |                  | Functional dentition |                  |                   |
|--------------------|---------------------------------|-------------------|--------------------|------------------|----------------------|------------------|-------------------|
|                    | PS                              | PS2               | PS                 | PS2              | PS                   | PS2              |                   |
| Age [years]        | 65–74                           | 36.8 (27.8–45.8)* | 21.1 (17.1–25.2)*  | 53.9 (46.6–61.3) | 54.5 (49.7–59.2)     | 9.3 (6.1–12.4)*  | 24.4 (19.6–29.2)* |
|                    | 75–84                           | 44.2 (39.6–48.8)  | 41.4 (37.3–45.5)   | 50.0 (45.3–54.7) | 48.3 (44.3–52.2)     | 5.7 (3.5–8.0)    | 10.3 (6.9–13.8)   |
|                    | $\geq 85$                       | 54.7 (47.1–62.4)  | 55.5 (49.0–62.1)   | 42.7 (34.9–50.5) | 41.1 (35.1–47.1)     | 2.6 (1.1–4.1)    | 3.4 (1.5–5.3)     |
| Education level    | primary                         | 45.3 (39.8–50.8)  | 41.4 (35.6–47.1)   | 50.4 (44.7–56.1) | 51.2 (46.0–56.5)     | 4.3 (0.6–8.0)    | 7.4 (4.0–10.7)    |
|                    | vocational                      | 44.7 (28.6–60.9)  | 27.6 (21.6–33.6)   | 48.9 (34.1–63.7) | 54.0 (47.5–60.6)     | 6.4 (2.2–10.6)*  | 18.3 (12.3–24.4)* |
|                    | secondary                       | 37.4 (29.0–45.7)  | 25.6 (21.3–29.8)   | 55.2 (46.3–64.2) | 50.7 (45.0–56.4)     | 7.4 (4.4–10.4)*  | 23.7 (18.3–29.2)* |
|                    | higher                          | 18.6 (10.5–26.8)  | 18.3 (12.4–24.1)   | 59.5 (48.3–70.7) | 49.1 (39.5–58.7)     | 21.9 (11.4–32.3) | 32.7 (22.9–42.4)  |
| Place of residence | rural area                      | 42.5 (37.3–47.8)* | 30.3 (25.9–34.6)*  | 53.7 (47.1–60.2) | 54.6 (49.6–59.6)     | 3.8 (1.1–6.5)*   | 15.1 (9.4–20.8)*  |
|                    | city (<50,000 residents)        | 38.8 (33.9–43.7)  | 30.6 (25.3–35.8)   | 54.3 (49.1–59.5) | 49.6 (43.7–55.6)     | 6.9 (4.2–9.7)*   | 19.8 (12.7–26.9)* |
|                    | city (50,000–200,000 residents) | 44.6 (38.3–50.9)  | 32.2 (23.3–41.0)   | 47.0 (39.7–54.4) | 45.5 (37.9–53.1)     | 8.4 (2.9–13.8)*  | 22.3 (15.4–29.3)* |
|                    | city (>200,000 residents)       | 35.7 (14.9–56.4)  | 23.0 (19.0–26.9)   | 51.5 (35.5–67.4) | 54.1 (46.9–61.4)     | 12.8 (7.1–18.6)  | 22.9 (15.1–30.8)  |

\* statistically significant difference between PS and PS2 ( $p < 0.05$ ,  $\chi^2$  test). Data presented as % (CI).

## Educational impact

The findings of both studies indicated a significant relationship between the level of education and dental status, irrespective of sex (Table 2 and Table 3). The highest percentage of edentulous individuals was observed among those with primary education: 58.5% of women in PS and 56.9% of women in PS2; and 45.3% of men in PS and 41.4% of men in PS2. The results suggest that the prevalence of edentulism decreases with increasing educational levels, reaching the lowest values among individuals with higher education, both among women and men.

Consequently, an increasing percentage of people with functional dentition was observed as the level of education increased in both sexes. In 2019, only 2.2% of women and 7.4% of men with primary education had more than 20 teeth, compared with one-third of those with higher education. Statistically significant changes between the 2 studies were observed in functional dentition in men with vocational and secondary education (Table 3), and in women with partial tooth loss who had received higher education (Table 2).

## Place of residence

The findings of both studies indicated a tendency toward improved dental conditions with an increase in the size of the place of residence.

The prevalence of edentulism significantly decreased among male residents of rural areas over the course of a decade, from 42.5% to 30.3% (Table 3). A positive trend in reducing toothlessness was also demonstrated in all urban centers, but without any statistically significant differences.

Positive and statistically significant changes were observed among respondents with functional dentition, irrespective of their sex and place of residence. The prevalence of functional dentition increased most markedly, by almost fivefold, in rural areas: from 0.9% to 5.3% in women and from 3.8% to 15.1% in men (Table 2 and Table 3).

## Discussion

The present study provides a comprehensive analysis of changing dental health patterns among Polish seniors in the context of global demographic aging trends, which forecast a substantial increase in the older population by the year 2050. This transition presents unique health-care challenges, including oral health. Notably, edentulism has been reported to affect over 60% of older adults in Brazil, while significantly lower rates have been observed in countries such as South Korea (11%) and Japan (13.8%).<sup>19–21</sup> These variations underscore the influence of geographic, economic and social factors on oral health outcomes on a global scale. For example, studies have

shown that rural residents of China are more susceptible to edentulism, while urban residents of Ghana and South Africa face higher rates of this condition.<sup>22</sup>

This study is notable for its use of nationally representative data to evaluate long-term trends in dental health among older adults in Poland. The findings of this study revealed a substantial improvement in oral health over the course of a decade. Specifically, the edentulism rate decreased from 45.8% to 36.1%, and functional dentition increased 2.5-fold from 6.0% to 15.0%, mirroring advancements observed in Europe.<sup>23,24</sup> However, despite the overall positive trend, Poland's rates remain higher than the WHO benchmark of less than 15% of individuals aged 65–74 years who are edentulous, a target already reached by Germany (10.7%), France (9.1%) and Denmark (6.8%). Moreover, Sweden and Switzerland have been observed to report some of the lowest rates of edentulism in Europe.<sup>25,26</sup> This discrepancy highlights the need for the implementation of targeted public health strategies aimed at mitigating disparities rooted in socioeconomic and regional factors.

In accordance with international research, our study demonstrated that lower education levels are associated with higher rates of edentulism.<sup>22</sup> Socioeconomic factors and limited dental visits have been identified as significant predictors of oral health disparities in both international and regional studies.<sup>27</sup> Polish seniors with primary education exhibited higher edentulism rates, with only 2.2% of women and 7.4% of men in this group retaining functional dentition. Individuals with higher education levels exhibited a significantly higher tooth retention rate of approx. 1/3.<sup>28</sup> These disparities reflect patterns observed in both Europe and the United States, where lower educational attainment correlates with increased rates of tooth loss and fewer preventive dental behaviors.<sup>14,29</sup> This correlation between the level of education and oral health suggests that improving health literacy and access to preventive care could significantly enhance outcomes in Poland.

Geographic location plays a vital role in shaping dental health. As observed in other regions of the world, urban Polish residents generally exhibit better oral health, attributable to higher access to healthcare services and socioeconomic advantages.<sup>30</sup> Our study also identified encouraging improvements among rural residents, where the prevalence of functional dentition among rural women increased nearly fivefold, from 0.9% to 5.3%, and among men from 3.8% to 15.1% over the decade.<sup>31,32</sup> These positive shifts may be influenced by public health initiatives targeting rural areas and broader efforts within the EU to reduce health inequities. However, continued investment is needed to effectively address the urban-rural disparities.

Differences in dental health between sexes were also observed. A decline in the prevalence of edentulism was observed among both sexes; however, men demonstrated a more significant improvement in functional dentition, with a rise from 7.8% to 19.0%.<sup>33</sup> This pattern may reflect recent health initiatives, changing health behaviors, or

differential access to dental care. In contrast, women, who generally adopt a more proactive stance toward preventive health measures, encounter additional risks such as postmenopausal bone loss and a prolonged life expectancy. These factors contribute to elevated edentulism rates among older women.<sup>34–37</sup>

The findings of the present study indicate significant generational differences, particularly between the 65–74 and ≥85 cohorts. The youngest seniors, born between 1945 and 1954, have experienced marked improvements in functional dentition and a decline in edentulism. These changes likely reflect the post-World War II advancements in healthcare and socioeconomic conditions that benefited this cohort. Conversely, the oldest group, born during a period of economic hardship, exhibits persistently high levels of edentulism, emphasizing the long-term impact of early-life socioeconomic conditions on oral health.<sup>28</sup>

The stability of the group with partial tooth loss over the decade can be understood by recognizing it as a transitional group. The decline in the number of edentulous individuals and the increase in functional dentition were influenced by advancements in dental care, education and preventive measures. As dental health has improved, older adults have been able to maintain a significant number of teeth, which increased the proportion of individuals with functional dentition. This shift potentially reduced the size of the group with partial tooth loss. At the same time, the reduction in the prevalence of edentulism has led to a reduction in tooth loss. Individuals who would have been edentulous in the past are now more likely to retain their teeth, placing them in the partial tooth loss category. Consequently, the partial dentition group has remained stable, balancing the increase in functional dentition and the decrease in edentulism.

The results of the present study underscore the critical role of targeted public health initiatives in addressing oral health disparities across various demographic factors, including age, education, sex, and geographic location. Several countries have successfully implemented models for such initiatives. For instance, mobile dental clinics in underserved rural areas, widely used in countries such as the United States and Australia, could expand access to preventive and restorative care in Poland's rural regions.<sup>38,39</sup> Similarly, training general practitioners to conduct basic oral health screenings, a common practice in Scandinavian countries, could enhance early detection and improve outcomes for older adults.<sup>40</sup> Educational programs promoting oral hygiene and addressing factors like tobacco use, modeled after Japan and South Korea's public health campaigns, could also be beneficial.<sup>41</sup>

## Limitations

While the present study offers valuable insights into the dental health trends among Polish older adults over a decade, several limitations must be acknowledged. First,

the response rates of 42% for PS and 56% for PS2 indicate potential sampling bias. Those who declined to participate may have had different oral health profiles compared to the participants, which could have affected the generalizability of the results. Furthermore, the cross-sectional design of the study provides a snapshot of health trends at 2 distinct points in time, which limits the ability to draw causal inferences regarding the factors driving changes in dental health between 2009 and 2019. Despite the efforts to standardize data collection methods across the 2 surveys, minor variations in data collection techniques or differences in participants' recollections over time may have introduced measurement bias. These potential differences could affect the comparability of the 2 cohorts. Finally, the findings of this study are largely applicable to Poland, and the generalizability of these results to other countries may be limited by differences in healthcare systems, economic conditions and demographic structures.<sup>17,18</sup>

## Conclusions

The comparative analysis of the PS (2009) and PS2 (2019) studies demonstrated a significant improvement in the dental health of Polish older adults over the span of a decade. These improvements are particularly evident in the youngest senior population (65–74 years), suggesting that advancements in dental care, increased health awareness and improved socioeconomic conditions have favorably impacted the oral health of older adults entering retirement age. Despite these encouraging developments, the study highlights persistent disparities related to sex, as well as sociodemographic factors, including education level and place of residence.

Continued efforts are necessary to maintain the positive trends observed and to ensure that all segments of the older adult population benefit equally from advancements in dental care. Collaboration among policymakers, healthcare providers and community organizations is crucial to prioritize oral health as a critical component of overall well-being in older adults. Future research should focus on longitudinal studies to monitor these trends and evaluate the effectiveness of implemented public health strategies. By doing so, Poland can work toward improving the quality of life for its aging population, contributing to better health outcomes and a more equitable society.

## Ethics approval and consent to participate

Not applicable.

## Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Consent for publication


Not applicable.


## Use of AI and AI-assisted technologies


Not applicable.


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