

Socioeconomic Position and Dental Care Utilization Among Screened Children in Switzerland: a retrospective registry-linked study

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Abstract

Background

Dental care in Switzerland is largely excluded from mandatory health insurance, and many cantons rely on school-based screening to promote equitable access to preventive care for children. We evaluated whether dental care utilization among screened children varies by socioeconomic position across three regional screening systems in the Canton of Valais, Switzerland.

Methods

We conducted a retrospective, registry-linked study combining an ecological (municipality-level) and an individual (patient-year-level) analysis of dental service utilization across three regionally distinct screening systems (Haut-Valais and Valais Romand, school-based; Cabinet, chairside), 2021–2025. Dental service records ($n = 1,203,543$; 46,845 patients) were linked to the cantonal screening registry. The primary sample comprised 66,418 screened patient-years, aggregated to 273 municipalities across three service categories for the primary rate-based regression; a supplementary negative binomial model used the same patient-years without aggregation. Socioeconomic position was assessed using the Swiss Neighbourhood Index of Socioeconomic Position (Swiss-SEP), with multiple testing addressed using the Holm correction.

Results

Municipality-mean Swiss-SEP was not associated with utilization rate in any service category after Holm correction (diagnostic: coefficient = 0.038, 95% CI – 0.240 to 0.316, $p = 0.787$; treatment: coefficient = 0.024, 95% CI – 0.090 to 0.138, $p = 0.681$; elective: coefficient = 0.043, 95% CI – 0.288 to 0.374, $p = 0.801$). In a supplementary, exploratory patient-year negative binomial model, a socioeconomic gradient was detected for curative/treatment consultations (incidence rate ratio = 0.58, 95% CI 0.43–0.78, highest vs lowest quintile, $p < 0.001$) but not for diagnostic ($p = 0.724$) or elective consultations ($p = 0.951$). Screening system, rather than socioeconomic position, was the more consistent predictor of utilization.

Conclusions

Dental screening reaches children equitably at the diagnostic stage across socioeconomic groups in the Canton of Valais. At the pre-specified municipality-rate level, utilization showed no socioeconomic gradient in any service category. A gradient concentrated in curative treatment was detected only in an individual-level count model that does not appropriately represent utilization as a rate and should be treated as provisional pending replication in an adequately powered analysis. These findings support

continued investment in universal school-based screening as a mechanism for equitable diagnostic contact.

Background

The Inverse Care Law, a foundational concept in health sociology from Julian Tudor Hart 1971, posits that the availability of high-quality medical care tends to vary inversely with the need for it in the population served [1]. In oral public health, this disparity is often exacerbated by the high out-of-pocket (OOP) costs associated with treatments, which can lead to significant barriers for low-income families or catastrophic health expenditures [1, 2]. Nonetheless, greater access to care does not necessarily translate into better health outcomes or better health status. This insight reflects a persistent historical pattern in which morbidity is inversely related to income, such as care utilisation with socio-economic status. Far from being a transient feature of post-war welfare systems, this principle predates the economic expansion of the 1950s and continues to be deeply embedded in contemporary health systems [3–5]. Consistent with this structural pattern, high-income countries allocate a significant and growing proportion of their resources to healthcare [6]. Switzerland exemplifies this trend, with healthcare expenditures representing a considerable fraction of national economic output and per capita spending among the highest globally [7]. Several factors may contribute to this upward trajectory, including demographic changes associated with population ageing, rising prevalence of chronic and complex diseases, higher individual incomes, escalating treatment costs, the introduction of novel therapies and pharmaceuticals, greater intensity of clinical interventions, and potential overutilization of services [8]. Despite recognition of these contributing elements, the relative impact of each on overall expenditure growth remains incompletely understood.

Switzerland represents a unique case study in dental care organization. Unlike general medical care, which is covered by mandatory basic health insurance (Assurance Maladie/KVG), dental care is largely excluded from basic coverage [9]. Consequently, Swiss dental care is characterized by a high degree of privatization and significant OOP expenditures for the majority of the population [10]. In Switzerland, dental expenses are primarily financed by households (approximately 60–80%), with a small portion covered by voluntary private insurance or specific social welfare programs. This financing model places a heavy burden on low-to-middle-income households, potentially leading to the renunciation of necessary care for economic reasons [11]. By contrast, neighbouring Germany and Austria also rely on private payment for dental services, but their statutory health insurance schemes cover a broader range of preventive and basic restorative treatments, particularly for children and adolescents, reducing OOP burdens and partially mitigating inequities in access [12]. Similarly, France and Italy provide more extensive public coverage for essential dental care, especially for vulnerable populations and minors, through social security systems and targeted subsidies [12].

To mitigate these disparities, many Swiss cantons and municipalities have implemented local dental welfare policies. These typically include school-based screening programs (*dépistage*) and subsidies designed to ensure that socio-economic status does not dictate oral health outcomes during childhood

and adolescence [13]. Within this framework, dental spending represents a significant economic pillar, yet it remains one of the most unequal sectors in terms of financial distribution and access, reinforcing the need for targeted public interventions to “flatten” the socio-economic gradient.

Methods

This study aimed to evaluate the Valais healthcare system and its screening programmes by examining socio-economic gradients in dental care utilization and expenditure, and to quantify how oral healthcare utilization is distributed across socio-economic groups, geographic areas, and over time. We hypothesized that dental care utilization, particularly for curative/treatment services, would be lower among children from more socio-economically disadvantaged backgrounds, and that this association would vary depending on screening system organisation.

This study used an integrated longitudinal dataset of patient-level dental service records and reimbursement data from the canton of Valais, Switzerland, covering the period from 1 January 2021 to 31 December 2025 and linked, via encrypted individual identifiers, to the cantonal school dental screening registry (*dépistage*).

Patients were screened and treated within one of three regional screening systems: (i) Haut-Valais and (ii) Valais Romand, both school-based (examinations on school premises, with referral to an external dental practice for treatment), differing only by German- vs French-speaking region; and (iii) Cabinet, a chairside model in selected Haut-Valais communes where dentists perform screening in clinical settings. Socio-economic position (SEP) was assessed using the Swiss-SEP index, a small-area, neighbourhood-level composite indicator of socio-economic position developed by the Swiss Federal Statistical Office [14]. The Swiss-SEP index integrates census-based indicators reflecting income and wealth, education, occupational status, and housing conditions, and is standardized to the national distribution. For each patient, the Swiss-SEP value was assigned via geocoded linkage to their place of residence and categorized into national quintiles, with Quintile 1 representing the most socio-economically disadvantaged neighbourhoods and Quintile 5 the most advantaged [15].

Service-level records were harmonised across data waves and aggregated to the patient–year level. Dental service codes were mapped onto three categories: Categories 1–3 (diagnostic/preventive), Categories 4–7 (curative/treatment), and Category 8 (orthodontic/elective). For the utilization analysis, the denominator comprised all children with at least one screening visit in the “*Dépistage*” registry (66,418 screened patient–years; 32,541 unique patients); consultations were zero-filled for screened patients with no recorded activity, yielding a patient–year–category grid ($n = 199,254$). Utilization was modelled as a rate, total consultations divided by the number of screened patients, computed per municipality per year and averaged across years, yielding one observation per municipality $\times$ service category (273 municipalities retained after excluding those with fewer than 5 screened patients). This primary analysis regressed municipality-mean utilization rate on municipality-mean Swiss-SEP, screening system, and municipality-mean age, separately for each of the three service categories. Scatterplots of

municipality-mean utilization rate against municipality-mean Swiss-SEP were inspected for each service category to confirm the appropriateness of a continuous SEP term (see Additional file: Figure S1). Multiple testing across the three service categories was addressed using the Holm correction, compared against a threshold of $\alpha = 0.0167$. Secondary interaction analyses between municipality-mean Swiss-SEP and screening system used a threshold of $\alpha = 0.0056$ and were conducted only if all three primary tests were significant. As a supplementary comparison, a negative binomial regression model was fitted at the patient-year level for each service category, with Swiss-SEP quintile, screening system, standardized age, and sex as covariates, and cluster-robust standard errors at the patient level. Descriptive statistics for dental expenditure per patient-year, by Swiss-SEP quintile and calendar year, are reported for context, without formal hypothesis testing. Descriptive statistics (mean, standard deviation, frequencies, and proportions) were computed for all primary variables. All analyses were performed using R version 4.3.3. As the analytic sample comprised all eligible children in the cantonal screening and service-utilisation registries rather than a drawn sample, no a priori sample size or power calculation was performed. Ethical approval was obtained from the Commission Cantonale d'Éthique de la Recherche sur l'être humain (CER-VD), Lausanne, Switzerland (n° 2025 – 01360, 27 May 2026). This study is reported in accordance with the STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) guidelines for observational studies.

Results

After cleaning, the utilization analysis dataset comprised 1,203,543 service records from 46,845 unique patients (Haut-Valais: 185,366; Cabinet: 83,425; Valais Romand: 934,752), of which 66,418 patient-years (32,541 patients) had a documented screening visit, aggregated to 273 municipalities for the primary regression analysis. Descriptively, mean diagnostic/preventive consultations per screened patient-year were similar across SEP quintiles, ranging from 2.60 (Quintile 5) to 2.83 (Quintile 1), with 65–68% of patients receiving at least one diagnostic visit in every quintile. A decreasing gradient was visible for treatment/curative consultations (1.17 in Quintile 1 vs 0.71 in Quintile 5) (see Additional file: Table S1).

In the municipality-level regression (see Additional file: Table S2), municipality-mean Swiss-SEP was not a statistically significant predictor of utilization rate in any service category, either before or after Holm correction: diagnostic ($p = 0.787$), treatment ($p = 0.681$), elective ($p = 0.801$). As all three primary tests were non-significant, secondary SEP $\times$ screening-system interaction tests were not performed. Screening system showed an independent association with diagnostic utilization: Cabinet municipalities had fewer diagnostic consultations than Haut-Valais ($p = 0.025$), and Valais Romand had more treatment consultations than Haut-Valais ($p = 0.029$).

In the supplementary patient-year negative binomial model, the Wald test for SEP quintile terms was significant for treatment consultations ($p < 0.001$) but not for diagnostic ($p = 0.724$) or elective consultations ($p = 0.951$). For treatment consultations, the incidence rate ratio decreased with increasing SEP quintile relative to Quintile 1: IRR = 0.90 (95% CI 0.86–0.94) for Quintile 2, 0.83 (0.78–0.89) for Quintile 3, 0.80 (0.71–0.90) for Quintile 4, and 0.58 (0.43–0.78) for Quintile 5.

Mean and median total dental expenditure per patient-year, by Swiss-SEP quintile and calendar year, are shown in Fig. 1. Mean expenditure was lower in Quintile 5 than in Quintiles 1–4 in every study year, while Quintiles 1–4 clustered closely together (CHF ~ 690–760) without a consistent gradient among themselves. The gap was largest in 2022 (CHF 752 in Quintile 1 vs CHF 432 in Quintile 5) and narrowest in 2024–2025 (~ CHF 130 difference). Mean expenditure exceeded the median in every cell (e.g. Quintile 1, 2021: mean = CHF 763, median = CHF 296), reflecting a right-skewed distribution consistent with a minority of costly interventions (e.g. orthodontics) raising the mean well above the typical patient's spending.

Mean and median total dental expenditure per patient-year, by screening system and calendar year, are shown in Additional file: Table S3. Overall, mean expenditure was highest in Haut-Valais (CHF 750, median CHF 286) and lowest in Valais Romand (CHF 687, median CHF 286), with Cabinet intermediate (CHF 719, median CHF 254). Haut-Valais showed higher mean expenditure than the other two systems in 2021–2023 (CHF 813–893), declining to CHF 655 in 2024 before rising again to CHF 723 in 2025. Cabinet remained comparatively stable across all five years (CHF 708–736). Valais Romand was stable at CHF 718–719 through 2023, fell to CHF 576 in 2024, and partially recovered to CHF 706 in 2025. Median expenditure was considerably more stable than the mean across all systems and years, consistent with the right-skewed distribution described above.

Discussion

This study examined socio-economic gradients in dental care utilization among schoolchildren served by three regional screening systems in the canton of Valais, Switzerland, over a five-year period. The central finding is that, when utilization is analysed as a rate at the municipality level, no statistically significant socioeconomic gradient was detected in any service category. A gradient concentrated in curative/treatment consultations was visible only in a supplementary, individual-level count model, which diverges from the primary specification.

The municipality-level model tests an ecological hypothesis: whether communities with a more disadvantaged average socioeconomic composition show different rates of care utilization than more advantaged communities. The individual-level model tests a compositional hypothesis: whether, independent of place of residence, children from lower socioeconomic backgrounds use care differently than their more advantaged peers. For diagnostic/preventive and elective/orthodontic consultations, neither the ecological nor the compositional analysis detected an association with socioeconomic position. This convergence provides the strongest available evidence that these two categories of care are equitably distributed, both across communities and across individuals. For treatment/curative consultations, the pattern diverged: a socioeconomic gradient was detected at the individual level but not at the municipality level. This asymmetry indicates that any inequity in curative care is compositional rather than geographic in origin: it is not that disadvantaged municipalities receive systematically less curative care as communities, but that, within any given municipality, children from lower-SEP families appear more likely to require or receive curative treatment. Because the ecological analysis found no

evidence of an area-based effect for any category, an interpretation centred on differential accumulated disease burden at the individual level is more consistent with the overall pattern of results than one invoking differential access to services by place of residence. Disadvantaged children may accumulate greater dental disease burden before detection, requiring more curative intervention once identified, rather than experiencing systematic under-referral at the diagnostic stage [16–19]. This is further supported by evidence that high-cost dental patients tend to present with greater accumulated oral disease and poorer preventive hygiene behaviours [16].

Screening system, rather than socioeconomic position, was the more consistently detected predictor of utilization at the municipality level, with an effect that varied by service category. Cabinet showed lower diagnostic and elective utilization relative to the school-based systems, the two categories most amenable to being incorporated into a single chairside visit, while curative utilization did not differ meaningfully between Cabinet and the school-based systems. This pattern is more consistent with a gain in efficiency, whereby combined screening-and-treatment visits reduce the need for separate diagnostic or elective appointments, than with reduced access to care. Valais Romand showed directionally higher utilization than Haut-Valais across all three categories, reaching significance for curative consultations and potentially indicative of a system that requires more contacts to achieve comparable outcomes; this interpretation would require provider- or pathway-level data beyond the scope of the present dataset to confirm. The present results support organisational structure, rather than socioeconomic position, as the more consistent driver of variation in dental care utilization across the screening systems studied.

These findings partially contrast with the pattern documented in other private-insurance-based systems (*i.e.*, the United States), where dental care utilization among children remains closely tied to insurance status and household income. National survey data for 2022 show a dental visit in the past year for 37.9% of children in households below the federal poverty level, compared with 64.4% of children in households at or above 400% of the poverty level, and for 63.2% of privately insured children compared with 43.7% of children covered by Medicaid or the Children's Health Insurance Program [20]. The absence of a comparable socioeconomic gradient in municipality-level utilization in the present Swiss cohort is consistent with the universal, no-cost design of school-based screening, which is not conditioned on insurance enrolment or ability to pay, unlike the U.S. system, in which dental benefits and utilization remain stratified by insurance type and household income.

Descriptively, mean total dental expenditure per patient-year was lower in the highest Swiss-SEP quintile than in the remaining quintiles across every study year. This pattern is reported descriptively only; formal inferential analysis of expenditure equity falls outside the scope of the present protocol. The marked right-skew of the expenditure distribution indicates that a small subset of high-cost interventions, such as orthodontic treatment, disproportionately influences the mean, such that the median more accurately represents typical patient-level spending. The descriptive expenditure pattern across screening systems adds a further dimension to this picture. Cabinet showed the most stable mean expenditure over time, consistent with its comparatively bundled, efficiency-oriented model of care delivery. Haut-Valais and

Valais Romand, by contrast, both showed a pronounced decline in mean expenditure in 2024 before a partial recovery in 2025; because median expenditure remained comparatively stable across the same period in both systems, this fluctuation in the mean is more likely attributable to a shift in the composition of high-cost interventions than to a genuine change in typical per-patient spending, and should not be over-interpreted without a breakdown by intervention type, which falls outside the descriptive scope of the present analysis. Nonetheless, screening improves horizontal equity in access, reaching children of all SEP backgrounds at comparable diagnostic rates, without eliminating vertical inequity in outcomes, since disadvantaged children enter the system with a greater disease burden [21, 22].

Strengths and limitations

This study benefits from a large administrative dataset (over 1.2 million service records and approximately 47,000 unique patients) spanning five years and three regional delivery systems, and from fine-grained socio-economic linkage via the validated Swiss-SEP index. However, several limitations should be noted. First, the Swiss-SEP index is a neighbourhood-level proxy that may attenuate true individual-level gradients. Second, need was inferred from utilization rather than from clinical severity. Third, the Cabinet system contributed few patient-years in 2024 ($n = 36$); these estimates are reported for completeness but excluded from trend interpretation. Fourth, the municipality-level primary analysis aggregates over a relatively small number of units (273 municipalities, several with modest patient counts), and the resulting reduction in statistical power relative to the patient-year specification should be considered when interpreting the absence of a significant SEP effect. Finally, private insurance coverage, out-of-canton care, and clinical severity indicators were not observed.

Conclusions

In the canton of Valais, dental screening reaches children equitably at the diagnostic stage across socio-economic groups. When utilization is analysed at the municipality level, no socioeconomic gradient in dental care utilization was detected in any service category. A gradient concentrated in curative treatment is visible only in an individual-level count model that does not appropriately represent utilization as a rate and should be treated as provisional pending replication at an adequately powered level of analysis. These findings support continued investment in universal school-based screening as a mechanism for equitable diagnostic contact.

Abbreviations

CHF

Swiss franc

CI

Confidence interval

IRR

Incidence rate ratio

KVG

Bundesgesetz über die Krankenversicherung (Swiss Federal Health Insurance Act; Assurance Maladie)

OOP

Out-of-pocket

SDJ

Association valaisanne pour la prophylaxie et les soins dentaires à la jeunesse

SEP

Socioeconomic position

SSO

Swiss Dental Association (Schweizerische Zahnärzte-Gesellschaft SSO)

STROBE

STrengthening the Reporting of OBservational studies in Epidemiology

Swiss-SEP

Swiss Neighbourhood Index of Socioeconomic Position

Declarations

Ethics approval and consent to participate

This study is a retrospective, registry-linked analysis of pre-existing, coded administrative dental-screening and reimbursement records (2021–2025); no participants were prospectively recruited or contacted. The Commission Cantonale d'Éthique de la Recherche sur l'être humain (CER-VD), Lausanne, Switzerland, the Institutional Review Board that approved the study (reference n° 2025-01360; approved 27 May 2026), waived the requirement for individual informed consent in accordance with the Art. 34 of the Swiss Federal Act on Research involving Human Beings (Human Research Act, HRA) of 30 September 2011 and its Ordinance on Human Research with the Exception of Clinical Trials (HRO), which permit the further use of coded health-related data for research without consent. All study procedures were conducted in accordance with the relevant Swiss legal framework governing research on human beings and with the ethical principles of the Declaration of Helsinki.

Consent for publication

Not applicable. This manuscript does not contain any individual person's data, images or case details in any form; all results are reported in aggregate.

Availability of data and materials

The datasets analysed during the current study are not publicly available because they contain patient-level dental service and screening records held under Canton of Valais data protection rules, but

aggregated data supporting the findings are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

DL designed the study, developed the statistical analysis plan in collaboration with TGW, performed the statistical analyses, and wrote the first draft of the manuscript. CS participated in data collection and data management. GC, AO, MG, KDJ, and CS contributed to the study design, the interpretation of the results, and the critical revision of the manuscript. MB and TGW also contributed to the study design, the interpretation of the results, and the critical revision of the manuscript. All authors read and approved the final manuscript.

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Figures

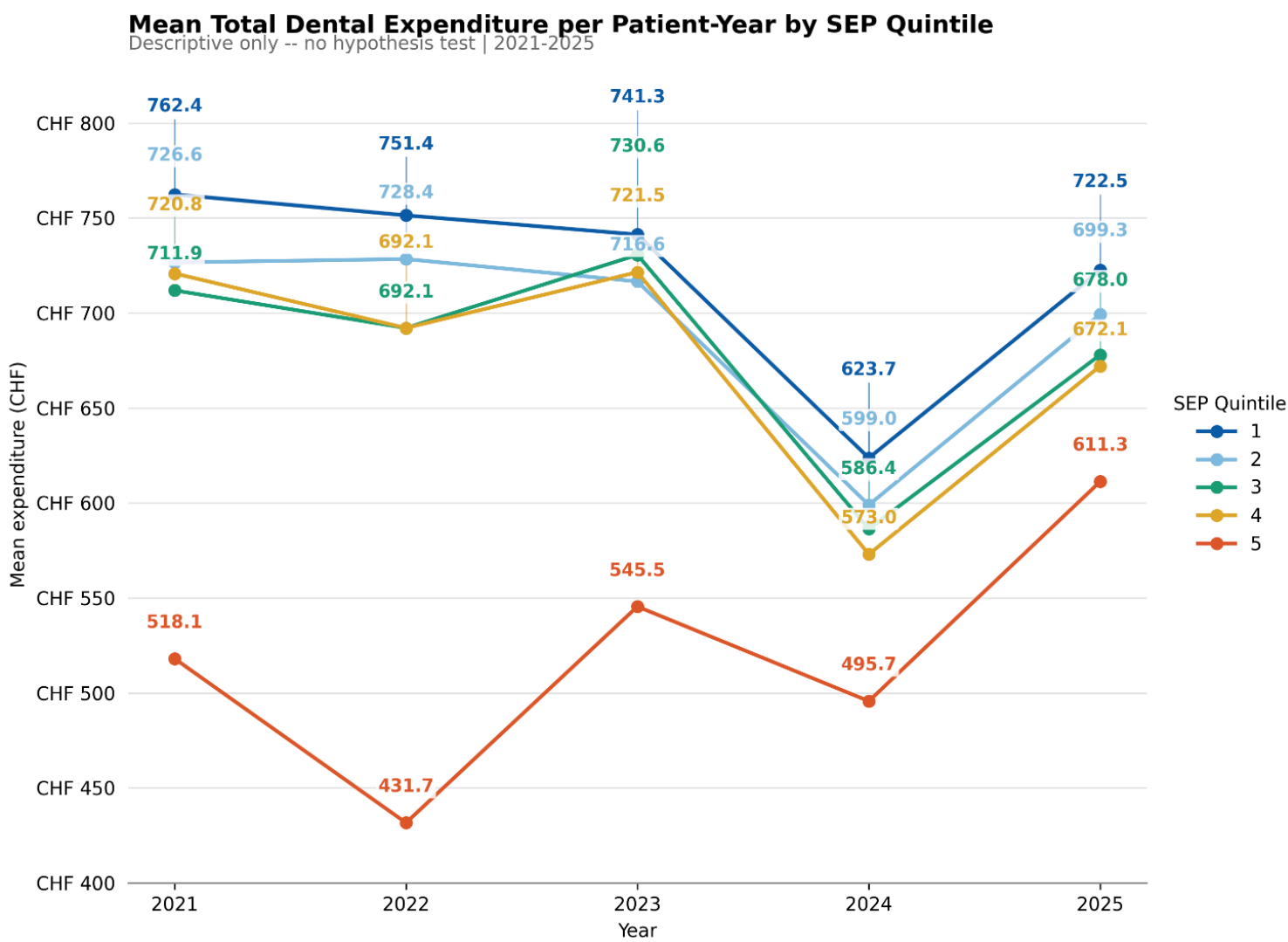


Figure 1

Mean (median) total dental expenditure (CHF) per patient-year, by Swiss-SEP quintile and year, 2021–2025.

Supplementary Files

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