

BENEFITS OF SUGAR-FREE GUM – INTERNATIONAL ANALYSIS

FINAL REPORT

20 MARCH 2025



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Global summary

What is good oral health?

Good oral health has many components. For example, the World Health Organisation (WHO) defines oral health as:

“The state of the mouth, teeth and orofacial structures that enables individuals to perform essential functions such as eating, breathing and speaking, and encompasses psychosocial dimensions such as self-confidence, well-being and the ability to socialise and work without pain, discomfort and embarrassment.”¹

Similarly, FDI World Dental Federation uses the following definition:

“Oral health is multi-faced and includes the ability to speak, smile, taste, touch, chew, swallow and convey a range of emotions through facial expressions with confidence and without pain, discomfort and disease of the craniofacial complex (head, face and oral cavity).”²

How can we prevent poor oral health?

While most oral health conditions are largely preventable, they still pose a significant global public health challenge. Almost 3.5 billion people worldwide were affected by oral diseases in 2019, with untreated dental caries (tooth decay) in permanent teeth being the most common health condition.³ The Global Burden of Disease study estimates that, in 2021, 2.2 billion people suffered from caries of permanent teeth and 525 million children suffered from caries of primary teeth.⁴

In many countries, both developed and developing, the human, financial and material resources to meet the need of oral health care services and to provide universal access are still insufficient. Despite the number of dentists and trained specialists in developed countries, dental health professionals do not adequately meet the need for prevention and focus mainly on curative care.⁵ Treatment for oral diseases is costly, both to individuals and health systems. In 2019, global direct expenditure for oral diseases totalled \$387 billion – 4.8% of global direct health expenditures – with a further \$323 billion lost to reduced productivity resulting from oral diseases.⁶

¹ World Health Organisation, https://www.who.int/health-topics/oral-health#tab=tab_1

² FDI World Dental Federation, <https://www.fdiworlddental.org/fdis-definition-oral-health>

³ World Health Organisation (2022), <https://www.who.int/publications/i/item/9789240061484>

⁴ Global Burden of Disease (2024), <https://www.healthdata.org/research-analysis/diseases-injuries-risks/factsheets>

⁵ Kandelman et al. (2012), <https://pubmed.ncbi.nlm.nih.gov/22909109/>

⁶ World Health Organisation (2022), <https://www.who.int/publications/i/item/9789240061484>

Given the challenges of availability and access to dental care, and the significant costs associated with treatments for oral health problems, it is important to consider the role of preventive interventions to support good oral health.

There are many interventions that can help to prevent poor oral health. These interventions vary in their cost, effectiveness, who implements them (government, dental practises, individuals and families), and the extent to which they are ‘targeted’ at – or are most valuable for – particular groups (such as children).

A Frontier Economics report for the Wrigley Oral Health Program in 2023⁷ focused on the UK and illustrated the potential for improving oral health through three preventive measures: (i) water fluoridation; (ii) sugar-free gum (SFG); and (iii) supervised brushing. In the current report, we again consider the use of SFG as an intervention for improving oral health through prevention, but broaden our analysis to include a number of countries with different dental care systems. In addition to revisiting and updating our UK analysis, we illustrate the potential impact of SFG for: (i) Australia; (ii) China; (iii) France; and (iv) Germany.

As well as the preventive interventions considered in this report and in Frontier Economics’ earlier report, other preventive oral health interventions exist but have not been included in the analyses. These include screening programmes,⁸ fluoride varnish,⁹ oral health education¹⁰ and fluoride supplements.¹¹

It is important to note that these interventions are not alternatives from which we need to choose a single option, nor are they substitutes for regular dental check-ups. They are complementary and might all play a role in improve oral health.

The role of sugar-free gum (SFG)

Chewing SFG can support good oral health by stimulating saliva production, which contributes to neutralising plaque acids, maintaining tooth mineralisation and removing harmful micro-organisms such as *streptococcus mutans*.¹²

Evidence suggests that chewing SFG (containing low- or zero-calorie sweeteners) two to three times a day can reduce the risk of caries, particularly among adolescents and young adults.¹³

⁷ Frontier Economics (2023), <https://www.frontier-economics.com/media/s2fix2ib/frontier-preventative-oral-health-value.pdf>

⁸ Arora et al. (2019), “School dental screening programmes for oral health”.

⁹ Marinho et al. (2013), “Fluoride varnishes for preventing dental caries in children and adolescents”.

¹⁰ Soldani et al. (2018), Stein et al. (2018)

¹¹ Tubert-Jeannin et al. (2011), Fluoride supplements (tablets, drops, lozenges or chewing gums) for preventing dental caries in children”.

¹² For example, see Dawes and Macpherson (1992), Stookey (2008), Karami-Nogourani et al. (2011), Nasseripour et al. (2021)

¹³ For example, see Möller and Poulsen (1973), Mäkinen et al. (1995), Beiswanger et al. (1998), Machiulskiene (2001)., Szöke et al. (2001)

Claxton et al. (2016) and Newton et al. (2020) reviewed previous studies that indicated a reduction in caries incidence of between 20% and 40% from chewing SFG. Table 1 below shows that the average amount of SFG consumed per person in the countries of interest in this report falls below the threshold of 3 pieces per day (1,095 per year), indicating that there is potential to increase SFG consumption in each of the countries.

Table 1 SFG-usage by country

	AU	CN	FR	DE	UK
Consumption per capita (pieces per year)	77	26	82	101	89

Source: Rychlik, R., et al. (2017). "A global approach to assess the economic benefits of increased consumption of sugar-free chewing gum".

As a preventive measure, SFG may be suitable for a wide population, including older children and adults, and there are no up-front costs (e.g. building water fluoridation infrastructure) or ongoing delivery costs. However, using chewing gum requires individuals to change their behaviour (e.g. chewing three pieces per day) and the cost of chewing gum is borne by the individual themselves.

The value of good oral health

Maintaining good oral health can avoid pain and discomfort associated with oral health problems. The WHO states that:

*"Oral health is a key indicator of overall health, well-being and quality of life."*¹⁴

While good oral health can prevent problems such as tooth decay and gum disease, and the associated treatments such as tooth fillings and tooth extractions, the potential benefits of good oral health are much broader.

Benefits and beneficiaries of good oral health

Good oral health primarily benefits individuals directly. Preventing dental problems means avoiding pain and discomfort, contributing to improved quality of life.¹⁵ Additionally, it reduces the need for dental visits and lowers associated costs of treatment.

These benefits to individuals may be enough to justify the costs of preventive interventions, particularly when the costs are relatively low. However, good oral health also has 'knock-on' and spillover benefits, with the main beneficiaries being health systems, schools and workplaces. Fewer dental treatments can lower costs in dental practices and hospitals, and

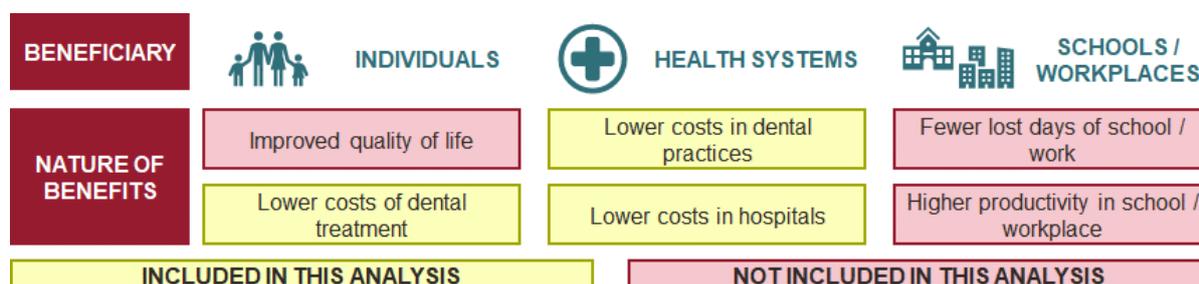
¹⁴ World Health Organisation, https://www.who.int/health-topics/oral-health#tab=tab_1

¹⁵ For example. See Baiju et al. (2017) and Lindmark et al. (2020).

free up additional capacity for other patients. It also means fewer school days missed for children and fewer work days missed for adults, either due to their own dental problems or to accompany children to their appointments.¹⁶

Figure 1 summarises these benefits and highlights which benefits have been considered within this report’s analysis. Further work considering the wider benefits of good oral health would be valuable. We note that by excluding these benefits from this analysis, our estimates provide an underestimate of the total benefits achieved from good oral health.

Figure 1 Benefits and beneficiaries of good oral health



Source: Frontier Economics

The state of oral health in the countries examined

Evidence from the WHO’s Global oral health status report shows that, of the countries examined in this report, the prevalence of untreated caries is highest in France (37%) and lowest in China (25%), with Australia (30%), Germany (32%) and the UK (31%) falling somewhere in between.¹⁷

The oral health of an individual is determined by a complex interaction of various factors including their access to dental care, public health policies, oral health literacy, socioeconomic status, diet and nutrition, cultural and behavioural factors. Our economic modelling includes a range for the current prevalence of caries to reflect the variation in oral health across different populations, and the extent to which using SFG as a preventive intervention can ‘target’ the highest-need individuals in a population. These ranges, along with the modelled oral health impacts of chewing SFG, are shown in Table 2 below.

Assuming a reduction in caries of 20 – 40%, we find that France could see the most caries avoided (per year) from chewing SFG (38 – 224 for every 1,000 people). These ‘caries avoided’ (calculated as the current prevalence of caries multiplied by the reduction in incidence of caries) can be interpreted as the ‘new’ caries that would have emerged, without the preventive benefit of chewing SFG.

¹⁶ For example, see Rebelo et al. (2018) and Lima and Buarque (2019).

¹⁷ <https://www.who.int/team/noncommunicable-diseases/global-status-report-on-oral-health-2022>

As a result of the caries avoided, a reduction in the frequency of dental check-ups may also occur, either because dentists advise a lower frequency or because patients (due to improved oral health in some cases) choose to attend less frequently. Evidence suggests that, of the countries analysed in this report, people in Germany visit the dentist most frequently (every 8 months, on average). This may be because of oral health incentives that can increase health insurance coverage, such as keeping an up-to-date dental bonus booklet. People in China visit the dentist less often (every 30 months, on average). This may be due to a number of reasons, such as those in rural areas not having sufficient access to dental care.

Table 2 Oral health impact of chewing SFG

	AU	CN	FR	DE	UK
Current prevalence of untreated caries	15 – 45%	13 – 38%	19 – 56%	16 – 48%	16 – 47%
Reduction in incidence of caries	All countries: 20 – 40%				
Impact: caries avoided per year	30 – 180 for every 1,000 people	26 – 152 for every 1,000 people	38 – 224 for every 1,000 people	32 – 192 for every 1,000 people	32 – 188 or every 1,000 people
Current frequency of dental appointments	Every 10 months	Every 30 months	Every 9 months	Every 8 months	Every 17 months
Proportion of individuals requiring fewer dental appointments	All countries: 0 – 10%				
Impact: new frequency of dental appointments, due to fewer dental caries ¹⁸	Every 14 months	Every 41 months	Every 12 months	Every 11 months	Every 24 months

Source: Frontier Economics analysis.

Notes: Caries avoided calculated as current prevalence of caries X reduction in incidence of caries; The new frequency of dental appointments due to fewer caries refers to appointments made due to the need to address caries, and not the

¹⁸ Calculated as: No. of months per year / (average number of dental check-ups per year * (1 – reduction in frequency of dental check-ups))

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*overall need to attend a dental check-up to maintain oral health.
FR = France; DE = Germany; UK = United Kingdom*

AU = Australia; CN = China;

The cost of dental treatment is dependent on a number of factors including the type of treatment (preventive vs. cosmetic), complexity of treatment (single vs. multiple root), location of treatment (urban vs. rural), the quality of material used and insurance coverage.

For example, the majority of dental services in Australia are provided through private dental clinics and each dental clinic is able to determine their own fees.¹⁹ As a result, the cost of dental treatment is generally higher compared to other countries analysed in this report. France, in contrast, has a universal statutory health insurance (SHI) system through which the majority of dentists must set fees in accordance with a uniform fee schedule for standard treatments and the treatment is reimbursed to the patient at a rate of 60 – 70%.²⁰ As a result, dental treatment costs are generally lower compared to other countries analysed.

Table 3 below shows the typical cost of the treatments of interest in this report for each country analysed.

Table 3 Typical cost of dental treatments in USD, 2024

	AU	CN	FR	DE	UK
Routine check-up	\$47	\$67	\$36	\$23	\$44
Tooth filling	\$135	\$82	\$68	\$69	\$132
Tooth extraction	\$144	\$60	\$55	\$27	\$132
Root canal treatment	\$217	\$150	\$94	\$232	\$132

Source: Frontier Economics analysis. AU = Australia; CN = China; FR = France; DE = Germany; UK = United Kingdom

An intervention that aims to increase SFG consumption among older children and adults (people aged 10+) as a means of preventing oral health issues could have significant benefits to the national healthcare system and wider population.

To estimate the potential national cost savings from an intervention designed to increase SFG consumption, we combine the cost of each treatment with the estimated number of treatments avoided to determine the potential cost savings (per person per year) from chewing SFG. We

¹⁹ <https://hwd.health.gov.au/resources/publications/factsheet-all-d-dentists-2019.pdf>

²⁰ <https://www.ameli.fr/assure/remboursements/rembourse/soins-protheses-dentaires-optique-audition/consultations-soins-protheses-dentaires/consultations-soins-dentaires>

then aggregate this cost up for the ‘target’ population – older children and adults (people aged 10+).

Table 4 below illustrates, for our central modelling scenario, the potential national cost savings if half of a country’s population aged 10+ were to increase SFG consumption to a minimum of 3 pieces per day. The largest impact on the national expenditure on dental care is in China – USD 2,633 million, equivalent to 39.5 million additional patient check-ups if reinvested. The smallest is in Australia – USD 105 million, equivalent to 2.2 million additional patient check-ups. The difference in potential national cost savings between countries is due to the difference in the size of the ‘target’ population.

Table 4 Annual national cost saving potential

	AU	CN	FR	DE	UK
Overall cost savings per person (scenario 2)	USD 12.72	USD 5.94	USD 7.38	USD 6.79	USD 11.46
Population reached	8.2m	448.2m	21.2m	26.4m	21.2m
Cost savings over population reached	USD 105m	USD 2,633m	USD 157m	USD 179m	USD 243m
National expenditure on dental care	USD 9,197m	USD 75,556m	USD 15,805m	USD 38,530m	USD 11,951m
Proportion of national expenditure on dental care (%)	1.14%	3.52%	0.99%	0.47%	2.04%
Additional check-ups	2.2m	39.5m	4.3m	7.7m	5.5m

Source: Frontier Economics analysis.

Note: Overall cost savings per person are taken from ‘scenario 2’ in each of the country sections of this report and converted to US Dollars to allow for a cross-country comparison.

AU = Australia; CN = China; FR = France; DE = Germany; UK = United Kingdom

The cost savings per person per year is highest in Australia and lowest in China. The differences in cost savings are predominantly driven by the differences in the cost of treatment across countries.

- In **Australia**, the overall cost savings from chewing SFG could be up to USD 39.38 per person per year.
- In **China**, the overall cost savings from chewing SFG could be up to USD 18.63 per person per year.
- In **France**, the overall cost savings from chewing SFG could be up to USD 22.50 per person per year.
- In **Germany**, the overall cost savings from chewing SFG could be up to USD 21.68 per person per year.
- In **the UK**, the overall cost savings from chewing SFG could be up to USD 35.55 per person per year.

Implications of findings

The findings of this report suggest that SFG – as well as other preventive oral health interventions not considered in detail here – could play a valuable role in improving the oral health of the population of a country. In particular, the findings highlight the potential for SFG to serve as a cost-effective public health intervention, particularly in reducing the economic burden associated with preventable oral health issues.

In addition to the reduced economic burden associated with preventable oral health issues, there are also potentially significant wider benefits than those we have modelled. For example, there are also benefits that stem from the general improvement in public health such as higher quality of life, a reduction in lost days of school / work and increased capacity for health systems. If these wider benefits were included, it would lead to a much higher estimate of the total benefits achieved from good oral health.

We recommend that all stakeholders – including global health organisations, national health departments, national dental associations and dental practitioners – consider placing a greater focus on preventive oral health interventions as part of a wider strategy to tackle the challenges in dentistry.

Methodology

‘What-if’ scenario modelling

We have modelled the potential impact on dental costs – for both health systems and for patients – of chewing SFG.²¹ We do this in four stages:

1. We have gathered together the published evidence on SFG-use as a preventive intervention.²²
2. We identify the reduction in oral health problems (e.g. tooth decay) that is estimated to result from chewing SFG.
3. We estimate the dental treatments (e.g. tooth extractions) that could be avoided as a result.
4. We estimate the cost saving to the health system and the patients from avoided dental treatments for each country.

These stages are illustrated in Figure 2 below.

Figure 2 Overview of ‘what-if’ Scenario modelling



Source: *Frontier Economics*

The published ‘impact evidence’ available, which links stages 1 and 2, is somewhat limited. This is due to there being relatively few long-running, ‘real-world’ trials of chewing SFG as a preventive intervention. The best current evidence suggests that regularly chewing SFG may reduce caries between 20% and 40%.²³ We believe the available evidence is sufficient to give an indication of the range of benefits that might be achieved, but not to confidently provide a firm estimate. We have therefore undertaken a ‘what-if’ analysis, in which we model a range

²¹ We define health systems to include both public and private health services, with the predominant form of dental care provision varying across the countries of interest in this report.

²² For the purpose of our modelling, we conservatively assume that the threshold for improving oral health is 3 pieces of SFG per day.

²³ See Claxton et al (2016) and Newton et al (2020).

of scenarios – representing larger and smaller potential impacts – to indicate the range of potential dental cost savings.

In stage 2, we estimate the number of oral health problems avoided relative to their current prevalence in the population for each country, focusing on routine check-ups, tooth fillings, tooth extractions and root canal treatment. The data on current prevalence of oral health problems provides a baseline for our economic modelling. Our baseline also includes the current frequency of dental appointments. We model a range of values to reflect some uncertainty in the target population that is reached and some data limitations. Across all countries, we assume the impact of chewing SFG on dental treatments avoided (stage 3) is the same.

The dental treatment cost evidence, which links stages 3 and 4, is more readily available for each country.

Table 5 Common impact assumptions across all countries

	Scenario 1	Scenario 2	Scenario 3
Reduction in incidence of caries	20%	30%	40%
Proportion of caries resulting in:			
- <i>Tooth extractions</i>	10%	30%	50%
- <i>Fillings</i>	20%	50%	70%
- <i>Root canal treatment</i>	5%	10%	20%
Reduction in frequency of check-ups from using SFG*	30%	30%	30%
Proportion of patients who experience reduction in dental check-ups	0%	5%	10%

Source: Frontier Economics based on published literature and expert clinical input..

Note: *Reduction in frequency of check-ups from using SFG refers to the reduction due to the need to address caries, and not the overall need to attend a dental check-up to maintain oral health.

We consider three impact scenarios in our analysis:

- **Scenario 1** provides a relatively conservative view of the likely impact.
- **Scenario 2** provides a more reasonable central estimate (around which there is significant uncertainty) of the likely impact.
- **Scenario 3** illustrates the greater potential impact amongst groups who typically have poorer oral health, such as those in deprived areas, from vulnerable groups (e.g.

homeless individuals or children in care), or those who have less-ingrained oral health routines.

The three scenarios modelled have been chosen to illustrate the broad range of potential ‘true’ impacts, given the relatively limited available evidence. Each scenario combines two different areas of underlying variation:

- **Current prevalence** – this reflects variation across different populations, and the extent to which using SFG as a preventive intervention can ‘target’ the highest-need individuals in a population.
- **Reduction in incidence** – this reflects the uncertainty in the impact of preventive interventions, even when using the best available evidence.

We note that the higher current prevalence is not what leads to the higher reduction in incidence. These two separate considerations are combined in our modelling for simplicity. Additionally, we note that there will typically be a ‘lag’ in the time taken for any preventive health intervention to have an impact on the population and that, if the oral health of the population were to improve over time, the ‘current prevalence would also decline. For simplicity, we have not modelled these interactions over time.

It is also important to note that the reduction in frequency of dental check-ups from using SFG refers to the reduction due to the need of caries treatment only. The incentives to go for regular check-ups to maintain good oral health remains unchanged with this intervention.

Limitations of our ‘what-if’ scenario modelling

The modelling presented in this report is limited in two main ways:

- There is relatively little high-quality evidence available for the countries and key impacts considered in this report. We have addressed this limitation by including broad ranges around our impact scenarios to increase confidence that the ‘true’ impact would fall within the ranges modelled. More detailed studies (e.g. to identify areas with high levels of caries) could allow better targeting of these measures and greater confidence that the benefits would be towards the top end of the ranges discussed.
- This analysis does not include all benefits. As shown in Figure 1, there are potentially significant benefits to individuals’ quality of life, to children’s education and to workers’ productivity. Modelling these benefits was beyond the scope of this report. As a consequence, the results presented are potentially significant under-estimates of the full societal benefit.

The modelling results offer an indication of the likely size of financial benefits from chewing SFG.

Australia

Summary of the dental care market

In Australia, the Medicare insurance scheme provides Australian citizens and permanent residents with access to healthcare, which includes a wide range of health and hospital services at low or no cost. However, in most cases, Medicare does not cover the cost of dental services such as routine cleanings, fillings or tooth extractions.²⁴

Approximately 90% of dental services are provided through private dental clinics,²⁵ and many people use private health insurance to help pay for dental care. Approximately 52% of people aged 5+ in Australia have private health insurance for dental cover.²⁶

These private health insurance policies do not typically cover the full cost of dental treatments. 76% of people with private insurance reported that health insurance paid some of the cost of treatment, with 12% reporting that insurance paid all of the cost and 9% reporting that insurance paid none of the cost. For the majority of patients who have private health insurance, out of pocket payments are still required and, on average, patients directly fund 60% of the cost of dental services.²⁷ Due to the privatised nature of dental care in Australia, meaning that each clinic is able to determine their own fees, dental costs vary widely between clinics. Table 6 shows, for each service that is of interest in this report, the average price a patient can expect to pay, and the share of these costs which are usually covered by private insurance.

With limited public funding for dental treatment, patients in Australia face significant financial burdens when accessing dental care. On average, 9% of adults report that dental visits were a large financial burden and 13% reported that they would have difficulty paying an AUD 200 dental bill.²⁸ The result is that people may not get the required treatment for any oral health issues that arise, worsening the oral health of the population over time. While private dental insurance can help, the need for out-of-pocket payments even when insured still poses an issue for some individuals – 47% of those without private dental insurance avoided or delayed dental care due to cost, compared to 19% of those with private dental insurance.²⁹

²⁴ <https://www.servicesaustralia.gov.au/medicare>

²⁵ <https://hwd.health.gov.au/resources/publications/factsheet-all-d-dentists-2019.pdf>

²⁶ <https://www.aihw.gov.au/reports/dental-oral-health/oral-health-and-dental-care-in-australia/contents/private-health-insurance>

²⁷ <https://www.aihw.gov.au/reports/dental-oral-health/oral-health-and-dental-care-in-australia/contents/costs>

²⁸ <https://www.aihw.gov.au/reports/dental-oral-health/oral-health-and-dental-care-in-australia/contents/costs>

²⁹ <https://www.aihw.gov.au/reports/dental-oral-health/oral-health-and-dental-care-in-australia/contents/costs>

Table 6 Cost of treatment and who bears the cost – Australia (2024)

	Typical cost	Proportion paid by private health system	Proportion paid by patient
Routine check-up	AUD 75.92	75%	25%
Tooth filling	AUD 217.29	52%	48%
Tooth extraction	AUD 232.31	48%	52%
Root canal treatment	AUD 349.03	41%	59%

Source: *Choice.com (2023): How much does the dentist cost?; Australian Institute of Health and Welfare (2024): Oral health and dental care in Australia - Private health insurance; Frontier Economics analysis.*

Note: *For Australia, we focus on private dental care provision and therefore look at the benefits to the patient and private insurer.*

Use of SFG

On average, people in Australia consume 77 pieces of SFG per year.³⁰ This is below the threshold of 3 pieces per day, which has been clinically proven to produce oral health benefits.³¹ The annual cost to an individual of chewing 3 pieces of SFG per day is AUD 115.³² The relatively low cost and potential to increase consumption to 3 pieces per day highlights the feasibility and cost-effectiveness of chewing SFG as a means of improving oral health in Australia.

Impact of SFG-use on the incidence of caries

Our economic modelling of the impact of chewing SFG in Australia is based on the ‘impact scenarios shown in Table 7 below.

Table 7 Impact scenarios - Australia

	Scenario 1	Scenario 2	Scenario 3
Current prevalence of untreated caries	15%	30%	45%

³⁰ Rychlik, R., et al. (2017). “A global approach to assess the economic benefits of increased consumption of sugar-free chewing gum”.

³¹ This is the amount of SFG that has been used in a number of clinical trials that found a positive caries prevention effect from chewing SFG.

³² Based on supermarket online grocery websites.

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	Scenario 1	Scenario 2	Scenario 3
Reduction in incidence of caries	20%	30%	40%
Impact: Caries avoided per year	3% or 30 caries for every 1,000 people	9% or 90 caries for every 1,000 people	18% or 180 caries for every 1,000 people
Current frequency of dental appointments	Every 10 months		
Impact: Proportion of individuals requiring fewer dental appointments	0%	5%	10%
New frequency of dental appointments, due to fewer dental caries ³³	Every 14 months		

Source: WHO (2022): Oral health Australia 2022 country profile; Australian Bureau of Statistics (2022): Patient Experiences; Frontier Economics analysis.

Notes: Caries avoided calculated as current prevalence of caries X reduction in incidence of caries; The new frequency of dental appointments due to fewer caries refers to appointments made due to the need to address caries, and not the overall need to attend a dental check-up to maintain oral health

Oral health is determined by a complex interaction of factors such as socioeconomic, environmental and cultural factors. For example: (i) the proportion of adults with untreated decay is highest in Western Australia (39.5%) and lowest in Queensland (22.6%); adults who are eligible for public dental care (typically those that are considered to be more vulnerable) are more likely to have untreated decay (34.5%) compared to those who are not eligible (31.1%); a higher proportion of adults without private dental insurance have untreated decay (38.6%) compared to those with private dental insurance (24.4%); and adults with less years of education have higher rates of untreated decay (36.9%) than those with more years of education (30.2%).³⁴

Table 7 above illustrates the modelled reduction in the prevalence of caries, from baseline values of 15% to 45%. The baseline value for scenario 2 is derived from WHO estimates of the prevalence of untreated caries.³⁵ The baseline values for scenarios 1 and 3 are adjusted to reflect the underlying variation across different populations, and the extent to which using SFG as a preventive intervention can ‘target’ the highest-need individuals.

³³ Calculated as: No. of months per year / (average number of dental check-ups per year * (1 – reduction in frequency of dental check-ups)) = 12 / (1.21 * (1 – 0.3)) = Once every 14 months.

³⁴ <https://www.aihw.gov.au/reports/dental-oral-health/oral-health-and-dental-care-in-australia/contents/healthy-teeth>

³⁵ <https://www.who.int/publications/i/item/9789240061484>

Taking scenario 2, for example, we assume that in the absence of chewing SFG, 30% of individuals have one cavity – equivalent to 300 out of every 1,000 individuals. We then assume that chewing SFG reduces this incidence across the population by 30%, meaning that only 210 out of every 1,000 individuals has one cavity. The overall impact is a reduction of 90 caries per 1,000 individuals in scenario 2. Note that this is not because chewing SFG has treated any of the initial 300 caries, rather that across the whole population, chewing SFG will prevent 30% of ‘new’ caries from emerging.

On average, people in Australia visit the dentist once every 10 months.³⁶ Table 7 shows that, under scenario 2, 5% of individuals see the frequency of their appointments fall from every 10 months to every 14 months. The reduction in frequency of dental check-ups may occur because dentists advise a lower frequency, or because patients (due to improved oral health in some cases) choose to attend less frequently.

Financial savings from chewing SFG

To estimate the cost savings of improved oral health from chewing SFG, we combine the cost of each treatment or service (presented in Table 6) with the number of treatments or services avoided.³⁷

Table 8 below summarises the potential annual cost savings from chewing SFG using our central scenario (scenario 2). The modelling suggests that increased use of SFG in Australia could have substantial benefits to the national healthcare system and the wider population, with national cost savings of up to AUD 338 million, if all of the intervention’s target population were to increase their SFG consumption to a minimum of 3 pieces per day.³⁸ If half of the intervention’s target population were to increase their SFG consumption to this threshold, this could amount to an aggregated cost saving of AUD 169 million (1.14% of the national expenditure on dental care).³⁹ The magnitude of these savings are equivalent to 2.2m additional check-ups.⁴⁰

These findings highlight the potential for SFG to serve as a cost-effective public health intervention, particularly in reducing the economic burden associated with preventable oral health issues.

³⁶ Australian Bureau of Statistics (2022): Patient Experiences.

³⁷ Calculated as: (No. of caries avoided * proportion of caries resulting in a given treatment * cost of a given treatment) + (reduction in frequency of check-ups * cost of check-up).

³⁸ Our modelling assumes that the target population for this intervention is older children and adults (anyone aged 10+), and that 70% of people are new to chewing 3 pieces of SFG per day.

³⁹ <https://www.who.int/publications/m/item/oral-health-aus-2022-country-profile>

⁴⁰ Calculated as: AUD 169 million / AUD 75.92 (cost of routine check-up from Table 6).

Table 8 National cost saving potential – Australia (scenario 2)

	10% reach	50% reach	100% reach
Overall cost savings per person ⁴¹		AUD 20.50	
Population reached	1.6m	8.2m	16.5m
Cost savings over population reached	AUD 34m	AUD 169m	AUD 338m
National expenditure on dental care		AUD 14,824m	
Proportion of national expenditure on dental care (%)	0.23%	1.14%	2.28%
Additional check-ups	445,000	2.2m	4.5m

Source: WHO (2022): Oral health Australia 2022 country profile; Frontier Economics analysis.

Note: [Insert Notes]

As indicated in Figure 1, there are potentially significant wider benefits than those we have modelled. In addition to the reduced economic burden associated with preventable oral health issues, there are also benefits from the general improvement in public health such as higher quality of life, a reduction in lost days of school/work and increased capacity for health systems. By excluding these wider benefits from this analysis, we present what is likely to be an underestimate of the total benefits achieved from good oral health.

⁴¹ Modelling results for the overall cost savings per person per year are AUD 2.52 in scenario 1 and AUD 63.48 in scenario 3.

China

Summary of the dental care market

Dental services in China are typically paid for via social medical insurance, out-of-pocket payments, or private health insurance. 95% of the total population is covered by the two social medical insurance schemes – Urban Employee Basic Medical Insurance (UEBMI) and Urban and Rural Resident Basic Medical Insurance (URRBMI).⁴²

These social insurance schemes are financed by the government and, in most areas, cover certain basic treatments including tooth extractions, tooth fillings, root canal treatment and periodontal treatment. Dental treatments that are for cosmetic purposes, however, are not covered by social insurance and must be covered by the patient out-of-pocket.

Reimbursement levels for the basic medical insurance schemes are typically low and evidence suggests that in practice over 85% of the total cost of dental treatment is paid out-of-pocket by the patient.⁴³ This out-of-pocket share can vary based on the type of hospital in which the treatment takes place, with Tier 1 Hospitals (community hospitals or clinics) having more insurance coverage and Tier 3 Hospitals (general hospitals) having less.

Some individuals may choose to purchase commercial dental insurance plans with additional coverage. These plans can provide more comprehensive benefits, including coverage for a wider range of dental treatments and higher reimbursement rates.

The cost of dental services in China can vary significantly based on the complexity of treatment, materials used, region, employment status and age. For example, the price of a tooth filling can vary based on the material used – local materials tend to be cheaper and covered to an extent by social insurance whereas imported materials are more expensive and must be paid for out-of-pocket. Table 9 below shows the typical prices for each of the services that are of interest in this report.

Table 9 Cost of treatment in China, 2024

	Typical Price	Proportion paid by public health system	Proportion paid by patient
Routine check-up	CNY 491.61	15%	85%
Tooth filling	CNY 600.86	15%	85%
Tooth extraction	CNY 436.99	15%	85%

⁴² Zhang et al. (2024). China’s universal medical insurance scheme: progress and perspectives.

⁴³ <https://pubmed.ncbi.nlm.nih.gov/21449210/>

	Typical Price	Proportion paid by public health system	Proportion paid by patient
Root canal treatment	CNY 1,092.46	15%	85%

Source: Du et al (2021) *The economic benefits of increased sugar-free chewing gum in China*; Zhuo et al. (2018) *Oral health in China*.

Use of SFG

Studies have found that the use of SFG in China is much lower than in other countries.⁴⁴ On average, people in China consume 26 pieces of SFG per year.⁴⁵ This is below the threshold of 3 pieces per day, which has been clinically proven to produce oral health benefits.⁴⁶ The cost to an individual of chewing 3 pieces of SFG per day in China is CNY 274.⁴⁷ This relatively low cost and potential to increase consumption to 3 pieces per day highlights the feasibility and cost-effectiveness of chewing SFG as a means of improving oral health in China.

Impact of SFG-use on the incidence of caries

Our economic modelling of the impact of chewing SFG in China is based on the impact scenarios shown in Table 10 below.

Table 10 Impact scenarios - China

	Scenario 1	Scenario 2	Scenario 3
Current prevalence of untreated caries	13%	25%	38%
Reduction in incidence of caries	20%	30%	40%
Impact: Caries avoided per year	2.6% or 26 caries for every 1,000 people	7.5% or 75 caries for every 1,000 people	15.2% or 152 caries for every 1,000 people
Current frequency of dental appointments	Every 30 months		

⁴⁴ Du et al., (2021). The economic benefits of increased sugar-free chewing gum in China: a budget impact analysis. BMC Oral Health 21.

⁴⁵ This data was collected in 2014, and is such not too reliable for current use.

⁴⁶ This is the amount that has been used in a number of clinical trials that found a positive caries prevention effect from chewing SFG.

⁴⁷ Based on supermarket online grocery websites.

	Scenario 1	Scenario 2	Scenario 3
Impact: Proportion of individuals requiring fewer dental appointments	0%	5%	10%
New frequency of dental appointments, due to fewer dental caries	Every 41 months		

Source: WHO (2022): Oral health country profile: China. Qu et al (2020) Disparities in Dental Service Utilization among Adults in Chinese Megacities. Zhu et al (2005) Oral health knowledge, attitudes and behaviour of adults in China.

Notes: Caries avoided calculated as current prevalence of caries X reduction in incidence of caries; The new frequency of dental appointments due to fewer caries refers to appointments made due to the need to address caries, and not the overall need to attend a dental check-up to maintain oral health

Dental service utilisation varies significantly across China, in part due to variation in the availability of dental care services and the level of oral health literacy.⁴⁸ Table 10 above illustrates the modelled reduction in the incidence of caries, from baseline values of 13% to 38%. The baseline value for scenario 2 is derived from WHO estimates of the prevalence of untreated caries.⁴⁹ The values for scenarios 1 and 3 are adjusted to reflect the underlying variation across different populations and the extent to which using SFG as a preventive intervention can ‘target’ the highest-need individuals in a population.

Taking scenario 2, for example, we assume that in the absence of chewing SFG, 25% of individuals have one cavity - equivalent to 250 out of every 1,000 individuals. We then assume that chewing SFG reduces this incidence across the population by 30%, meaning that only 175 out of every 1,000 individuals has a cavity. The overall impact is a reduction of 75 caries per 1,000 individuals in scenario 2. Note this is not because chewing SFG has treated any of the initial 250 caries, rather that across the whole population, chewing SFG will prevent 25% of ‘new’ caries from emerging.

On average, people in China visit the dentist relatively infrequently at once every 30 months.⁵⁰ Table 10 shows that, under scenario 2, 5% of individuals see the frequency of their appointments fall from every 30 months to every 41 months. The reduction in frequency of dental check-ups may occur because dentists advise a lower frequency, or because patients (due to improved oral health in some cases) choose to attend less frequently.

⁴⁸ Qu et al. (2020). Disparities in Dental Service Utilization among Adults in Chinese Megacities: Do Health Insurance and City of Residence Matter? <https://www.mdpi.com/1660-4601/17/18/6851>

⁴⁹ WHO (2022): Oral health country profiles: China.

⁵⁰ Qu et al (2020) Disparities in Dental Service Utilization among Adults in Chinese Megacities. Zhu et al (2005) Oral health knowledge, attitudes and behaviour of adults in China

Financial savings from chewing SFG

To estimate the cost savings of improved oral health from chewing SFG, we combine the cost of each treatment (shown in Table 9 above) with the number of treatments or services avoided.

Table 11 below summarises the potential annual cost savings from chewing SFG using our central scenario (scenario 2). The modelling suggests that increased use of SFG in China could have substantial benefits to the national healthcare system and the wider population, with national cost savings of up to CNY 38,876 million, if all of the intervention’s target population were to increase their SFG consumption to a minimum of 3 pieces per day.⁵¹ If half of the intervention’s target population were to increase their SFG consumption to this threshold, this could amount to an aggregated cost saving of CNY 19,428 million (3.52% of the national expenditure on dental care).⁵² By reinvesting this cost saving, it could fund approximately 40 million additional patient check-ups.⁵³

These findings highlight the potential for SFG to serve as a cost-effective public health intervention, particularly in reducing the economic burden associated with preventable oral health issues.

Table 11 National cost saving potential – China (scenario 2)

	10% reach	50% reach	100% reach
Overall cost savings per person ⁵⁴		CNY 43.37	
Population reach	89.6m	448.2m	896.4m
Cost savings over population reached	CNY 3,888m	CNY 19,428m	CNY 38,876m
National expenditure on dental care		CNY 551,507m	
Proportion of national expenditure on dental care (%)	0.70%	3.52%	7.05%
Additional check-ups	7.9m	40m	79m

Source: Frontier Economics analysis

⁵¹ Our modelling assumes that the target population for this intervention is older children and adults (anyone aged 10+), and that 70% of people are new to chewing 3 pieces of SFG per day.

⁵² <https://www.who.int/publications/m/item/oral-health-chn-2022-country-profile>

⁵³ Calculated as: CNY 19,428 million / CNY 491.61 (cost of routine check-up from Table 9)

⁵⁴ Modelling results for the overall cost savings per person per year are CNY 5.68 in scenario 1 and CNY 135.97 in scenario 3.

BENEFITS OF SUGAR-FREE GUM – INTERNATIONAL ANALYSIS

As indicated in Figure 1, there are potentially significant wider benefits than those we have modelled. In addition to the reduced economic burden associated with preventable oral health issues, there are also benefits from the general improvement in public health such as higher quality of life, a reduction in lost days of school/work and increased capacity for health systems. By excluding these wider benefits from this analysis, we present what is likely to be an underestimate of the total benefits achieved from good oral health.

France

Summary of the dental care market

France runs a statutory health insurance (SHI) system that provides universal coverage for its residents. The health financing system in France is largely financed through employee and employer contributions, and increasingly through public funding.⁵⁵

In terms of dental care, coverage under the SHI includes preventive, conservative and surgical treatment, a limited range of prosthetics and, if applications are approved, also orthodontic treatment.⁵⁶ Treatments are reimbursed at a rate of 60 – 70% in accordance with a uniform fee schedule set by the SHI.⁵⁷

Dentists are categorised as contracted or non-contracted: (i) Sector 1 contracted dentists apply the fees set by the SHI for all standard treatments and are not able to charge excess fees; (ii) Sector 2 contracted dentists are able to charge excess fees above the state-set fees but must do so “tactfully and moderately”; and (iii) Sector 3 non-contracted dentists are free to set fees without constraints.⁵⁸

84% of dentists are categorised as Sector 2 or Sector 3 and, as a result, the typical price for dental treatment is higher than the state-set fees – the average overcharge on dental treatment was 43% in 2022.⁵⁹

Complementary private health insurance (*mutuelle*) plays a large role in France, with over 95% of the population having some form of private coverage to supplement the reimbursements from SHI.⁶⁰ In practice, complementary private health insurance is the main source of financing for dental care in France, and covered 45% of dental expenditure in 2022.⁶¹

Table 12 below presents the typical cost and level of coverage of the dental treatments of interest in this report, once accounting for dentist overcharges.

⁵⁵ <https://eurohealthobservatory.who.int/countries/france>

⁵⁶ <https://eurohealthobservatory.who.int/publications/i/oral-health-care-in-europe-financing-access-and-provision>

⁵⁷ <https://www.ameli.fr/assure/remboursements/rembourse/soins-protheses-dentaires-optique-audition/consultations-soins-protheses-dentaires/consultations-soins-dentaires>

⁵⁸ <https://www.service-public.fr/particuliers/vosdroits/F17042>

⁵⁹ <https://drees.solidarites-sante.gouv.fr/sites/default/files/2023-09/CNS23-Fiche%2010%20-%20Les%20soins%20de%20dentistes.pdf>

⁶⁰ <https://eurohealthobservatory.who.int/countries/france>

⁶¹ <https://drees.solidarites-sante.gouv.fr/sites/default/files/2023-09/CNS23-Fiche%2010%20-%20Les%20soins%20de%20dentistes.pdf>

Table 12 Cost of treatment and who bears the cost – France (2024)

	Typical cost	Proportion paid by public health system	Proportion paid by patient
Routine check-up	EUR 35.22	51%	49%
Tooth filling	EUR 66.68	44%	56%
Tooth extraction	EUR 53.07	44%	56%
Root canal treatment	EUR 91.17	44%	56%

Source: *L'Assurance Maladie (2024): Consultations et soins dentaires: vos remboursements; Frontier Economics analysis.*

Note: *The typical cost of a treatment is calculated as the weighted average between the costs applied by a Secteur 1 dentist (standard cost) and Secteur 2 dentists (standard cost + 43% overcharge). The proportion paid by the public health system is calculated as the SHI reimbursement amount as a share of the typical cost of a treatment.*

Use of SFG

On average, people in France consume 82 pieces of SFG per year.⁶² This is below the threshold of 3 pieces per day, which has been clinically proven to produce oral health benefits.⁶³ The cost to an individual of chewing 3 pieces of SFG per day is EUR 67.⁶⁴ The relatively low cost and potential to increase consumption to 3 pieces per day highlights the feasibility and cost-effectiveness of chewing SFG as a means of improving oral health in France.

Impact of SFG-use on the incidence of caries

Our economic modelling of the impact of chewing SFG in France is based on the 'impact scenarios' shown in Table 13 below.

Table 13 Impact scenarios - France

	Scenario 1	Scenario 2	Scenario 3
Current prevalence of untreated caries	19%	37%	56%

⁶² Rychlik, R., et al. (2017). "A global approach to assess the economic benefits of increased consumption of sugar-free chewing gum".

⁶³ This is the amount of SFG that has been used in a number of clinical trials that found a positive caries prevention effect from chewing SFG.

⁶⁴ Based on supermarket online grocery websites.

BENEFITS OF SUGAR-FREE GUM – INTERNATIONAL ANALYSIS

	Scenario 1	Scenario 2	Scenario 3
Reduction in incidence of caries	20%	30%	40%
Impact: Caries avoided per year	3.8% or 38 caries for every 1,000 people	11.1% or 111 caries for every 1,000 people	22.4 % or 224 caries for every 1,000 people
Current frequency of dental appointments	Every 9 months		
Impact: Proportion of individuals requiring fewer dental appointments	0%	5%	10%
New frequency of dental appointments, due to fewer dental caries	Every 12 months		

Source: WHO (2022): Oral health France 2022 country profile; ; EC Eurostat (2023): Consultation of a dentist per inhabitant; Frontier Economics analysis.

Notes: Caries avoided calculated as current prevalence of caries X reduction in incidence of caries; The new frequency of dental appointments due to fewer caries refers to appointments made due to the need to address caries, and not the overall need to attend a dental check-up to maintain oral health

Table 13 above illustrates the modelled reduction in the incidence of caries, from baseline values of 19% to 56%. The baseline value for France for scenario 2 is derived from WHO estimates of the prevalence of untreated caries.⁶⁵ The values for scenarios 1 and 3 are adjusted to reflect the underlying variation across different populations and the extent to which using SFG as a preventive intervention can ‘target’ the highest-need individuals in a population.

Taking scenario 2, for example, we assume that in the absence of chewing SFG, 37% of individuals have one cavity – equivalent to 370 out of every 1,000 individuals. We then assume that chewing SFG reduces this incidence across the population by 30%, meaning that only 259 out of every 1,000 individuals has one cavity. The overall impact is a reduction of 111 caries per 1,000 individuals in scenario 2. Note that this is not because chewing SFG has treated any of the initial 370 caries, rather that across the whole population, chewing SFG will prevent 30% of ‘new’ caries from emerging.

On average, people in France visit the dentist once every 9 months.⁶⁶ Table 13 shows that, under scenario 2, 5% of individuals see the frequency of their appointments fall from every 9

⁶⁵ WHO (2022): Oral health France 2022 country profile.

⁶⁶ [https://ec.europa.eu/eurostat/databrowser/view/hlth_hc_dent\\$defaultview/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/hlth_hc_dent$defaultview/default/table?lang=en)

months to once a year, every 12 months. This reduction in frequency of dental check-ups may occur because dentists advise a lower frequency, or because patients (due to improved oral health in some cases) choose to attend less frequently.

Financial savings from chewing SFG

To estimate the cost savings of improved oral health from chewing SFG, we combine the cost of each treatment or service shown in Table 12 with the number of treatments or services avoided.⁶⁷

Table 14 below summarises the potential annual cost savings from chewing SFG using our central scenario (scenario 2). The modelling suggests that increased use of SFG in France could have substantial benefits to the national healthcare system and the wider population, with national cost savings of up to EUR 303 million, if all of the intervention’s target population were to increase their SFG consumption to a minimum of 3 pieces per day.⁶⁸ If half of the intervention’s target population were to increase their SFG consumption to this threshold, this could amount to an aggregated cost saving of EUR 151 million (0.99% of the national expenditure on dental care).⁶⁹ By reinvesting this cost saving, it could fund approximately 4.3 million additional patient check-ups.⁷⁰

These findings highlight the potential for SFG to serve as a cost-effective public health intervention, particularly in reducing the economic burden associated with preventable oral health issues.

Table 14 National cost saving potential – France (scenario 2)

	10% reach	50% reach	100% reach
Overall cost savings per person ⁷¹		EUR 7.13	
Population reached	4.2m	21.2m	42.4m
Cost savings over population reached	EUR 30m	EUR 151m	EUR 303m

⁶⁷ Calculated as: (No. of caries avoided * proportion of caries resulting in a given treatment * cost of a given treatment) + (reduction in frequency of check-ups * cost of check-up).

⁶⁸ Our modelling assumes that the target population for this intervention is older children and adults (anyone aged 10+) and that 70% of people are new to chewing 3 pieces of SFG per day.

⁶⁹ <https://www.who.int/publications/m/item/oral-health-fra-2022-country-profile>

⁷⁰ Calculated as EUR 151 million / EUR 35.22 (cost of routine check-up from Table 12)

⁷¹ Modelling results for the overall cost savings per person per year are EUR 0.87 in scenario 1 and EUR 21.74 in scenario 3.

BENEFITS OF SUGAR-FREE GUM – INTERNATIONAL ANALYSIS

	10% reach	50% reach	100% reach
National expenditure on dental care		EUR 15,268m	
Proportion of national expenditure on dental care	0.20%	0.99%	1.98%
Additional check-ups	859,000	4.3m	8.6m

Source: *Frontier Economics analysis.*

As indicated in Figure 1, there are potentially significant wider benefits than those we have modelled. In addition to the reduced economic burden associated with preventable oral health issues, there are also benefits from the general improvement in public health such as higher quality of life, a reduction in lost days of school/work and increased capacity for health systems. By excluding these wider benefits from this analysis, we present what is likely to be an underestimate of the total benefits achieved from good oral health.

Germany

Summary of the dental care market

Health insurance in Germany is compulsory and provided either through statutory health insurance (SHI) or compulsory private health insurance. In 2023, the SHI system consisted of 96 ‘sickness funds’ and covered approximately 89% of the population.⁷² For certain occupational groups (such as civil servants and self-employed workers) and high earners, it is possible to opt out of SHI coverage and instead enrol with private health insurance (PHI), which has broader coverage options. In 2023, PHI was provided by 44 insurance companies and covered around 11% of the population.⁷³

Basic dental care and surgical treatment are included in the benefits package of sickness funds.⁷⁴ In relation to the treatments and services of interest in this report, that includes a routine check-up twice a year, tooth fillings, tooth extractions with local anaesthesia, and root canal treatment if the tooth is deemed worthy of preserving.

In certain circumstances, however, the patient may be required to pay some expenses out-of-pocket. For example, if a patient opts for a more premium material for a tooth filling (e.g. plastic or ceramic), undertakes a tooth extraction with general anaesthesia or nitrous oxide, or if a tooth is not deemed worth preserving via root canal treatment, then any costs exceeded the costs of standard care must be paid out-of-pocket.⁷⁵

For more complex procedures, SHI covers a fixed subsidy amount of 60% of the costs of standard care, with patients paying the remaining cost out-of-pocket. This fixed subsidy can be increased if the insured person can provide evidence of yearly dental examinations to keep their teeth healthy via a dental bonus booklet. Proving yearly dental examinations in the last five years increases the subsidy to 70%, and in the last ten years increases the subsidy to 75%.⁷⁶

Complementary dental insurance policies to supplement the coverage provided through SHI are becoming increasingly popular. Between 2012 and 2021, the number of people with complementary dental insurance increase by 31% from 13.6 million to 17.8 million.⁷⁷ These

⁷² https://health.ec.europa.eu/document/download/1b4f8d46-d378-4626-8aeb-630e7ee61420_en?filename=2023_chp_de_english.pdf

⁷³ https://health.ec.europa.eu/document/download/1b4f8d46-d378-4626-8aeb-630e7ee61420_en?filename=2023_chp_de_english.pdf

⁷⁴ <https://eurohealthobservatory.who.int/publications/i/oral-health-care-in-europe-financing-access-and-provision>

⁷⁵ <https://feather-insurance.com/blog/public-insurance-dental/>

⁷⁶ <https://eurohealthobservatory.who.int/publications/i/oral-health-care-in-europe-financing-access-and-provision>

⁷⁷ <https://www.pkv.de/verband/presse/meldungen/starker-zuwachs-178-millionen-deutsche-haben-eine-zahnzusatzversicherung/>

policies can help to cover up to 100% of the remaining out-of-pocket expense paid for by patients for dental treatments.

Table 15 below summarises the typical prices and level of coverage for each of the services that are of interest in this report.

Table 15 Cost of treatment and who bears the cost – Germany (2024)

	Typical price	Proportion paid by public health system	Proportion paid by patient
Routine check-up	EUR 22.50	100%	0%
Tooth filling	EUR 66.25	100%	0%
Tooth extraction	EUR 25.63	100%	0%
Root canal treatment	EUR 224.42	60%	40%

Source: Zimmer, S., et al (2018). « Elevating the use of sugar-free chewing gum in Germany: cost saving and caries prevention”; BZÄK (2025); <https://eurohealthobservatory.who.int/publications/i/oral-health-care-in-europe-financing-access-and-provision>

Note: In the case of root canal treatment, there are many factors that contribute to the cost and in some cases a patient may have to pay part of the cost because public insurance providers only cover the cost of standard treatment. For this reason, we assume a coverage rate of 60% (the standard coverage rate of SHI).

Use of SFG

On average, people in Germany consume 101 pieces of SFG per year.⁷⁸ This is below the threshold of 3 pieces per day, which has been clinically proven to produce oral health benefits⁷⁹ The cost to an individual of chewing 3 pieces of SFG per day is EUR 66.⁸⁰ The relatively low cost and potential to increase consumption to 3 pieces per day highlights the feasibility and cost-effectiveness of chewing SFG as a means of improving oral health.

Impact of SFG-use on the incidence of caries

Our economic modelling of the impact of chewing SFG in Germany is based on the ‘impact scenarios’ shown below in Table 16.

⁷⁸ Rychlik, R., et al. (2017). “A global approach to assess the economic benefits of increased consumption of sugar-free chewing gum”.

⁷⁹ This is the amount of SFG that has been used in a number of clinical trials that found a positive caries prevention effect from chewing SFG.

⁸⁰ Based on supermarket online grocery websites.

Table 16 Impact scenarios - Germany

	Scenario 1	Scenario 2	Scenario 3
Current prevalence of untreated caries	16%	32%	48%
Reduction in incidence of caries	20%	30%	40%
Impact: Caries avoided per year	3.2% or 32 caries for every 1,000 people	9.6% or 96 caries for every 1,000 people	19.2% or 192 caries for every 1,000 people
Current frequency of dental appointments	Every 8 months		
Impact: Proportion of individuals requiring fewer dental appointments	0%	5%	10%
New frequency of dental appointments, due to fewer dental caries ⁸¹	Every 11 months		

Source: WHO (2022): Oral health Germany 2022 country profile; EC Eurostat (2024): Consultation of a dentist per inhabitant; Frontier Economics analysis.

Notes: Caries avoided calculated as current prevalence of caries X reduction in incidence of caries; The new frequency of dental appointments due to fewer caries refers to appointments made due to the need to address caries, and not the overall need to attend a dental check-up to maintain oral health

Table 16 above illustrates the modelled reduction in the prevalence of caries, from baseline values of 16% to 48%. The baseline value for scenario 2 is derived from WHO estimates of the prevalence of untreated caries.⁸² The values for scenarios 1 and 3 are adjusted to reflect the underlying variation across different populations and the extent to which using SFG as a preventive intervention can ‘target’ the highest-need individuals in a population.

Taking scenario 2, for example, we assume that in the absence of chewing SFG, 32% of individuals have one cavity – equivalent to 320 out of every 1,000 individuals. We then assume that chewing SFG reduces this incidence across the population by 30%, meaning that only

⁸¹ Calculated as: No. of months per year / (average number of dental check-ups per year * (1 – reduction in frequency of dental check-ups) = 12 / (1.5 * (1 – 0.3)) = Once every 11 months.

⁸² <https://www.who.int/publications/m/item/oral-health-deu-2022-country-profile>

224 out of every 1,000 individuals has one cavity. The overall impact is a reduction of 96 caries per 1,000 individuals in scenario 2. Note that this is not because chewing SFG has treated any of the initial 320 caries, rather that across the whole population, chewing SFG will prevent 30% of ‘new’ caries from emerging.

On average, people in Germany visit the dentist relatively frequently – once every 8 months.⁸³ Table 16 above shows that, under scenario 2, we assume that 5% of individuals see the frequency of their appointments fall from every 8 months to every 11 months. The reduction in frequency of dental check-ups may occur because dentists advise a lower frequency, or because patients (due to improved oral health in some cases) choose to attend less frequently.

Financial savings from chewing SFG

To estimate the cost savings of improved oral health from chewing SFG, we combine the cost of each treatment or service (presented in Table 15) with the number of treatments or services avoided.⁸⁴

Table 17 below summarises the potential annual cost savings from chewing SFG using our central scenario (scenario 2). The modelling suggests that increased use of SFG in Germany could have substantial benefits to the national healthcare system and the wider population, with national cost savings of up to EUR 347 million, if all of the intervention’s target population were to increase their SFG consumption to a minimum of 3 pieces per day.⁸⁵ If half of the intervention’s target population were to increase their SFG consumption to this threshold, this could amount to an aggregated cost saving of EUR 173 million (0.47% of the national expenditure on dental care).⁸⁶ By reinvesting this cost saving, it could fund approximately 7.7 million additional patient check-ups.⁸⁷

These findings highlight the potential for SFG to serve as a cost-effective public health intervention, particularly in reducing the economic burden associated with preventable oral health issues.

⁸³ [https://ec.europa.eu/eurostat/databrowser/view/hlth_hc_dent\\$defaultview/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/hlth_hc_dent$defaultview/default/table?lang=en)

⁸⁴ Calculated as: (No. of caries avoided * proportion of caries resulting in a given treatment * cost of a given treatment) + (reduction in frequency of check-ups * cost of check-up).

⁸⁵ Our modelling assumes that the target population for this intervention is older children and adults (anyone aged 10+) and that 70% of people are new to chewing 3 pieces of SFG per day.

⁸⁶ <https://www.who.int/publications/m/item/oral-health-deu-2022-country-profile>

⁸⁷ Calculated as: EUR 173 million / EUR 22.50 (cost of routine check-up from Table 15)

Table 17 National cost saving potential – Germany (scenario 2)

	10% reach	50% reach	100% reach
Overall cost saving per person ⁸⁸		EUR 6.55	
Population reached	5.3m	26.4m	52.9m
Cost savings over population reached	EUR 35m	EUR 173m	EUR 347m
National expenditure on dental care		EUR 37,220m	
Reduction in national expenditure on dental care (%)	0.09%	0.47%	0.93%
Additional check-ups	1.5m	7.7m	15.4m

Source: Frontier Economics analysis.

As indicated in Figure 1, there are potentially significant wider benefits than those we have modelled. In addition to the reduced economic burden associated with preventable oral health issues, there are also benefits from the general improvement in public health such as higher quality of life, a reduction in lost days of school/work and increased capacity for health systems. By excluding these wider benefits from this analysis, we present what is likely to be an underestimate of the total benefits achieved from good oral health.

⁸⁸ Modelling results for the overall cost savings per person per year are EUR 0.72 in scenario 1 and EUR 20.95 in scenario 3.

United Kingdom

Summary of the dental care market

Since 1999, health care has become a devolved responsibility across the four nations of the UK, but the tax-funded NHS model is common in all four nations.

The dental services reimbursed by the NHS is wide-ranging and includes diagnosis, prevention, periodontal treatment, operative treatment, surgical treatment, dental prostheses and orthodontic treatment. In all four nations, NHS treatment is free of charge for those under the age of 18, nursing and expectant mothers, and those with low incomes.⁸⁹ This exemption is extended to those under 25 and over 60 in Wales, and those under 26 in Scotland.

In England and Wales, costs of dental treatment are split into 3 NHS charge bands:^{90,91}

- **Band 1:** patient contribution of £26.80 in England and £20 in Wales. Includes an examination, diagnosis and preventive care
- **Band 2:** patient contribution of £73.50 in England and £60 in Wales. Includes all necessary treatment covered in Band 1 plus fillings, root canal treatments, extractions and periodontal treatment
- **Band 3:** patient contribution of £319.10 in England and £260 in Wales. Includes all necessary treatment covered in Band 1 and 2 plus more complex procedures such as crowns, dentures and bridges.
- **Urgent care:** patient contribution of £26.80 in England and £30 in Wales.

In Scotland and Northern Ireland, non-exempt adult patients contribute 80% of up to £384 per course of treatment.^{92,93}

Individuals in the UK are increasingly purchasing private insurance for dental treatment, either in the form of dental insurance or an addition to general medical insurance. It is estimated that 3.8 million people in the UK were covered by private dental plans or insurance in 2022.⁹⁴

⁸⁹ <https://www.nhs.uk/nhs-services/dentists/who-is-entitled-to-free-nhs-dental-treatment-in-england/>

⁹⁰ <https://www.nhs.uk/nhs-services/dentists/how-much-will-i-pay-for-nhs-dental-treatment/>

⁹¹ <https://www.gov.wales/nhs-dental-charges-and-exemptions>

⁹² <https://www.nhsinform.scot/care-support-and-rights/nhs-services/dental/receiving-nhs-dental-treatment-in-scotland/#dental-treatment-costs>

⁹³ <https://www.nidirect.gov.uk/articles/dental-costs>

⁹⁴ <https://dentistry.co.uk/2024/04/19/private-dental-insurance-uptake-at-record-high-report-says/#:~:text=New%20research%20suggests%20that%203.8,from%203.2%20million%20in%202019.>

In practice, the NHS bears a significant cost of dental treatments. In 2023-24, overall spend on primary care NHS dentistry was £3.1 billion in 2023-24.⁹⁵ Table 18 below summarises the typical prices and level of coverage for each of the services that are of interest in this report.

Table 18 Cost of treatment in the UK, 2024

	Typical cost	Proportion paid by public health system	Proportion paid by patient
Routine check-up	GBP 35	23%	77%
Tooth filling	GBP 105	30%	70%
Tooth extraction	GBP 105	30%	70%
Root canal treatment	GBP 105	30%	70%

Source: NHS (2024) : How much will I pay for NHS dental treatment

Note: These costs have been updated from Frontier Economics' previous report.

Use of SFG

On average people in the UK consume around 89 pieces of SFG a year.⁹⁶ This is below the threshold of 3 pieces per day, which has been clinically proven to produce oral health benefits.⁹⁷ The cost to an individual of chewing 3 pieces of SFG per day in the UK is GBP 55.⁹⁸ The relatively low cost and potential to increase consumption to 3 pieces per day highlights the feasibility and cost-effectiveness of chewing SFG as a means of improving oral health.

Impact of SFG-use on the incidence of caries

Our economic modelling of the impact of chewing SFG in the UK is based on the 'impact scenarios' shown in Table 19 below.

⁹⁵ <https://www.nao.org.uk/wp-content/uploads/2024/11/Investigation-into-the-NHS-dental-recovery-plan-HC-308-summary.pdf>

⁹⁶ Rychlik et al. (2017). A global approach to assess the economic benefits of increased consumption of sugar-free chewing gum.

⁹⁷ This is the amount of SFG that has been used in a number of clinical trials that found a positive caries prevention effect from chewing SFG.

⁹⁸ Based on supermarket online grocery websites.

Table 19 Impact scenarios – UK

	Scenario 1	Scenario 2	Scenario 3
Current prevalence of untreated caries	16%	31%	47%
Reduction in incidence of caries	20%	30%	40%
Impact: Caries avoided per year	3.2% or 32 caries for every 1,000 people	9.3% or 93 caries for every 1,000 people	18.8% or 188 caries for every 1,000 people
Current frequency of dental appointments	Every 17 months		
Impact: Proportion of individuals requiring fewer dental appointments	0%	5%	10%
New frequency of dental appointments, due to fewer dental caries	Every 24 months		

Source: WHO (2022): Oral health country profile:UK.; Clinical and Experimental Dental Research – Screenivasan (2016).; EC Eurostat (2024).

Note: Data on the current prevalence of caries and current frequency of dental appointments has been updated from Frontier Economics’ previous report in order to align data sources used for multiple countries in this report. The assumption for the reduction in incidence of caries by scenario has also been updated from the previous report in line with updated data and expert input. Caries avoided calculated as current prevalence of caries X reduction in incidence of caries. The new frequency of dental appointments due to fewer caries refers to appointments made due to the need to address caries, and not the overall need to attend a dental check-up to maintain oral health.

Table 19 above illustrates the modelled reduction in the incidence of caries, from baseline values of 16% to 47%. The baseline value for scenario 2 is derived from WHO estimates of the prevalence of untreated caries.⁹⁹ The values for scenarios 1 and 3 are adjusted to reflect the underlying variation across different populations and the extent to which using SFG as a preventive intervention can ‘target’ the highest-need individuals in a population. Variations in oral health across the UK populations could be explained by the recent overburden of NHS practices, with many across the country not accepting new patients,¹⁰⁰ a barrier for many in receiving dental care.

⁹⁹ WHO (2022) :Oral health country profile: UK

¹⁰⁰ <https://www.bda.org/media-centre/nhs-dentistry-at-a-tipping-point-as-bbc-reveal-true-extent-of-access-crisis/>

Taking scenario 2, for example, we assume that in the absence of chewing SFG, 31% of individuals have one cavity – equivalent to 310 out of every 1,000 individuals. We then assume that chewing SFG reduces this incidence across the population by 30%, meaning that only 217 out of every 1,000 individuals has one cavity. The overall impact is a reduction of 93 caries per 1,000 individuals in scenario 2. Note that this is not because chewing SFG has treated any of the initial 310 caries, rather that across the whole population, chewing SFG will prevent 30% of ‘new’ caries from emerging.

On average, people in the UK visit the dentist relatively infrequently, once every 17 months. Table 19 shows that, under scenario 2, we assume that 5% of individuals see the frequency of their appointments fall from every 17 months to every 24 months. The reduction in frequency of dental check-ups may occur because dentists advise a lower frequency, or because patients (due to improved oral health in some cases) choose to attend less frequently.

Financial savings from chewing SFG

To estimate the cost savings of improved oral health from chewing SFG, we combine the typical cost of each treatment or service, shown in Table 18 above, with the number of treatments or services avoided.

Table 20 below summarises the potential annual cost savings from chewing SFG using our central scenario (scenario 2). The modelling suggests that increased use of SFG in the UK could have substantial benefits to the national healthcare system and the wider population, with national cost savings of up to GBP 388 million, if all of the intervention’s target population were to increase their SFG consumption to a minimum of 3 pieces per day.¹⁰¹ If half of the intervention’s target population were to increase their SFG consumption to this threshold, this could amount to an aggregated cost saving of GBP 194 million (2.04% of the national expenditure on dental care).¹⁰² By reinvesting this cost saving, it could fund approximately 5.5 million additional patient check-ups.¹⁰³

These findings highlight the potential for SFG to serve as a cost-effective public health intervention, particularly in reducing the economic burden associated with preventable oral health issues.

¹⁰¹ Our modelling assumes that the target population for this intervention is older children and adults (anyone aged 10+) and that 70% of people are new to chewing 3 pieces of SFG per day.

¹⁰² <https://www.who.int/publications/m/item/oral-health-gbr-2022-country-profile>

¹⁰³ Calculated as: GBP 194 million / GBP 35 (cost of routine check-up from Table 18)

Table 20 National cost saving potential – UK (scenario 2)

	10% reach	50% reach	100% reach
Overall cost saving per person ¹⁰⁴		GBP 9.14	
Population reached	4.2m	21.2m	42.4m
Cost savings over population reached	GBP 39m	GBP 194m	GBP 388m
National expenditure on dental care		GBP 9,526m	
Reduction in national expenditure on dental care (%)	0.41%	2.04%	4.07%
Additional check-ups	1.1m	5.5m	11.1m

Source: Frontier Economics analysis.

As indicated in Figure 1, there are potentially significant wider benefits than those we have modelled. In addition to the reduced economic burden associated with preventable oral health issues, there are also benefits from the general improvement in public health such as higher quality of life, a reduction in lost days of school/work and increased capacity for health systems. By excluding these wider benefits from this analysis, we present what is likely to be an underestimate of the total benefits achieved from good oral health.

¹⁰⁴ Modelling results for the overall cost savings per person per year are GBP 1.18 in scenario 1 and GBP 28.33 in scenario 3.

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