smw swiss medical weekly

Physical inactivity attributable burden of disease on morbidity and mortality across Swiss language regions: a population-based modelling study

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Published
24 September 2026

doi
https://doi.org/10.57187/5162

Cite this as
Swiss Med Wkly. 2026;156:5162

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Summary

BACKGROUND: Physical inactivity is a major risk factor for noncommunicable diseases, contributing to both substantial morbidity and premature mortality. In Switzerland, the prevalence of physical inactivity varies across language regions. This study aimed to quantify differences across Swiss language regions in the physical inactivity-attributable burden of disease, expressed as Years Lived with Disability (YLD) and Years of Life Lost (YLL) for 2022. The analysis focuses on YLD and YLL attributable to physical inactivity across 15 physical inactivity-associated diseases.

METHODS: This study employed the Population Attributable Fraction approach to estimate the proportion of YLD and YLL attributable to physical inactivity in Switzerland. The analysis included individuals aged >20 years and was stratified by disease, age, sex and language region (German-, French- and Italian-speaking). Physical inactivity was defined according to WHO guidelines as not meeting at least 150 minutes of moderate or 75 minutes of vigorous physical activity per week. Prevalence data on physical inactivity were derived from the 2022 Swiss Health Survey. Prevalences were combined with relative risks (RR) of corresponding diseases, identified through a systematic literature search to derive Population Attributable Fractions. Estimates of YLD and YLL for Switzerland for 2022 were derived from the Global Burden of Disease study. YLD and YLL estimates attributable to physical inactivity are presented as rates per 100,000 people aged >20 years. Uncertainty was assessed using parametric bootstrapping.

RESULTS: Overall, the physical inactivity-attributable burden of disease was estimated at 227.08 (95% CI: 214.74–240.08) YLD and 424.23 (95% CI: 383.15–479.23) YLL per 100,000 people aged >20 years. This corresponds to approximately 2% of total DALYs in Switzerland in 2022. Clear regional differences were observed. Estimated physical inactivity-attributable YLD rates were highest in the Italian-speaking region (134.90; 95% CI: 122.04–148.25) followed by the French-speaking region (130.72; 95% CI: 120.78–141.50) and German-speaking region (96.26; 95% CI: 88.81–104.01). Similarly, estimated YLL rates attributable to physical inactivity were highest in the Italian-speaking region (287.74; 95% CI: 245.82–349.99), followed by the French-speaking region (221.56; 95% CI: 192.54–264.55) and German-speaking region (186.67; 95% CI: 162.64–222.27). Disease-specific analysis indicated that depression (93.38; 95% CI: 85.46–101.80) and low back pain (52.01; 95% CI: 45.90–58.47) contributed most to physical inactivity-attributable YLD rates, whereas coronary heart disease (132.12; 95% CI: 115.60–149.55) and Alzheimer's disease and dementia (83.61; 95% CI: 51.90–134.97) were the main contributors to physical inactivity-attributable YLL rates. Women showed consistently higher burden of disease than men, with physical inactivity-attributable YLD rates of 286.06 (95% CI: 264.58–308.90) versus 166.32 (95% CI: 155.06–178.44) and physical inactivity-attributable YLL rates of 475.23 (95% CI: 404.85–577.64) versus 371.69 (95% CI: 337.50–414.96).

CONCLUSION: Results of this analysis suggest that physical inactivity significantly contributes to YLD and YLL rates in Switzerland, with pronounced regional and sex-specific disparities. The higher burden of disease observed in the Italian- and French-speaking regions highlights the need for regionally tailored prevention strategies that address cultural and contextual differences.

Introduction

Globally, physical inactivity represents a major contributor to noncommunicable diseases such as cardiovascular disease, cancer, depression and type 2 diabetes, and contributes substantially to premature mortality worldwide [1-3]. Despite physical activity being one of the most effective and accessible preventive measures, a substantial share of the population remains physically inactive. A 2024 Lancet Global Health study reported that 31.3% of adults, around 1.8 billion people worldwide, did not meet World Health Organization (WHO) physical activity recommendations in 2022, up from 23.4% in 2000 [4]. Furthermore, most countries are off track to achieve the WHO reduction target by 2030 [4]. In Switzerland, one-quarter of the population fails to meet the WHO's physical activity guidelines, underscoring the ongoing public health relevance of this issue [5].

Physical inactivity has been defined as not meeting the WHO's guidelines of at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity per week. Moderate-intensity physical activity involves activities ranging from 3 to 6 METs, while vigorous-intensity physical activity includes activities exceeding 6 METs [3]. (A metabolic equivalent of task (MET) expresses the energy expenditure of an activity relative to resting energy expenditure; one MET corresponds to approximately 3.5 ml of oxygen consumed per kilogram of body mass per minute. [50])

In 2022, physical inactivity-related mortality in Switzerland was reported at 1621 deaths, accounting for 2.2% of all deaths, with coronary heart diseases (26%) and dementia (20%) as leading causes [6]. However, the full impact of physical inactivity on morbidity and mortality becomes clearer when differentiating between its non-fatal and fatal consequences, measured by Years Lived with Disability (YLD) and Years of Life Lost (YLL). YLD reflects the years individuals live with health impairments and diminished functional capacity while YLL captures the years of life prematurely lost. This distinction is critical in public health as it provides a comprehensive view of physical inactivity's dual burden of disease: diminishing quality of life and reducing life expectancy. A sole focus on mortality is insufficient, as the burden of noncommunicable diseases stems largely from long-term morbidity, making it essential to consider both YLD and YLL in assessing the true population impact of physical inactivity [7].

Beyond health impacts, physical inactivity also imposes a significant economic burden. If global physical inactivity levels persist, an estimated INT$ (international dollars) 520 billion in direct public healthcare costs could accrue worldwide between 2020 and 2030, with high-income countries bearing 63% of these costs [8]. Studies have estimated direct costs attributable to physical inactivity ranging from 0.3% to 4.6% of national healthcare spending. These estimates derive mainly from high-income countries [9]. Crucially, YLD accounts for a large share of costs, mainly through the long-term management of chronic conditions such as cardiovascular disease, type 2 diabetes and depression, highlighting YLD as a key driver of the economic burden [10]. This reinforces the need for urgent and cost-effective interventions, especially as the global prevalence of physical inactivity continues to rise [4].

Physical inactivity is interrelated with complex socioeconomic and regional factors. Social and environmental determinants may even play a more significant role in health outcomes than clinical data alone. Social and economic factors, behaviour and environmental conditions account for approximately 60% of health outcomes like chronic diseases, mental health disorders and life expectancy, whereas healthcare services contribute only 10% and genetic factors account for the remaining 30% [12].

In Switzerland, regional differences in health opportunities are influenced by linguistic and cultural diversity. For example, the place of residence or the "postal code" impacts access to healthy food, green spaces and medical services [11, 13-15]. The prevalence of physical inactivity varies among German-, French- and Italian-speaking regions, with language regions serving as independent predictors of physical activity levels [16, 17]. Understanding these regional differences will provide valuable insights into targeted interventions and public health strategies to reduce the impact of physical inactivity on morbidity and mortality in Switzerland.

ABBREVIATIONS
DALY Disability-Adjusted Life Years
GAPPA Global Action Plan on Physical Activity 2018–2030
GBD Global Burden of Disease
YLD Years Lived with Disability
YLL Years of Life Lost

The aim of this study was therefore to quantify differences across Swiss language regions in physical inactivity-related burden of disease, based on YLD and YLL for 2022.

Methods

General approach

The study follows the STREAMS-P tool, a methodological guideline for the estimation of attributable health outcomes [18]. Figure 1 represents a summary of the methodological approach. In short, physical inactivity-related diseases associated with physical inactivity were identified through a comprehensive literature review. For each identified physical inactivity-related disease, its corresponding risk ratio (RR) was derived from a systematic literature search. RRs were combined with prevalence data, derived from the Swiss Health Survey 2022 to calculate Population Attributable Fractions. YLD and YLL for 2022 were retrieved from Global Burden of Disease (GBD) in October 2025 [19]. Population Attributable Fractions were multiplied with YLD and YLL values to estimate the physical inactivity-attributable burden of disease. To ensure consistency and comparability with previous research, the methodological framework as shown in figure 1 builds upon prior studies that evaluated the impact of physical inactivity on different health outcomes [6, 17, 20]. Each of the individual steps are described in more detail in the subsequent sections.

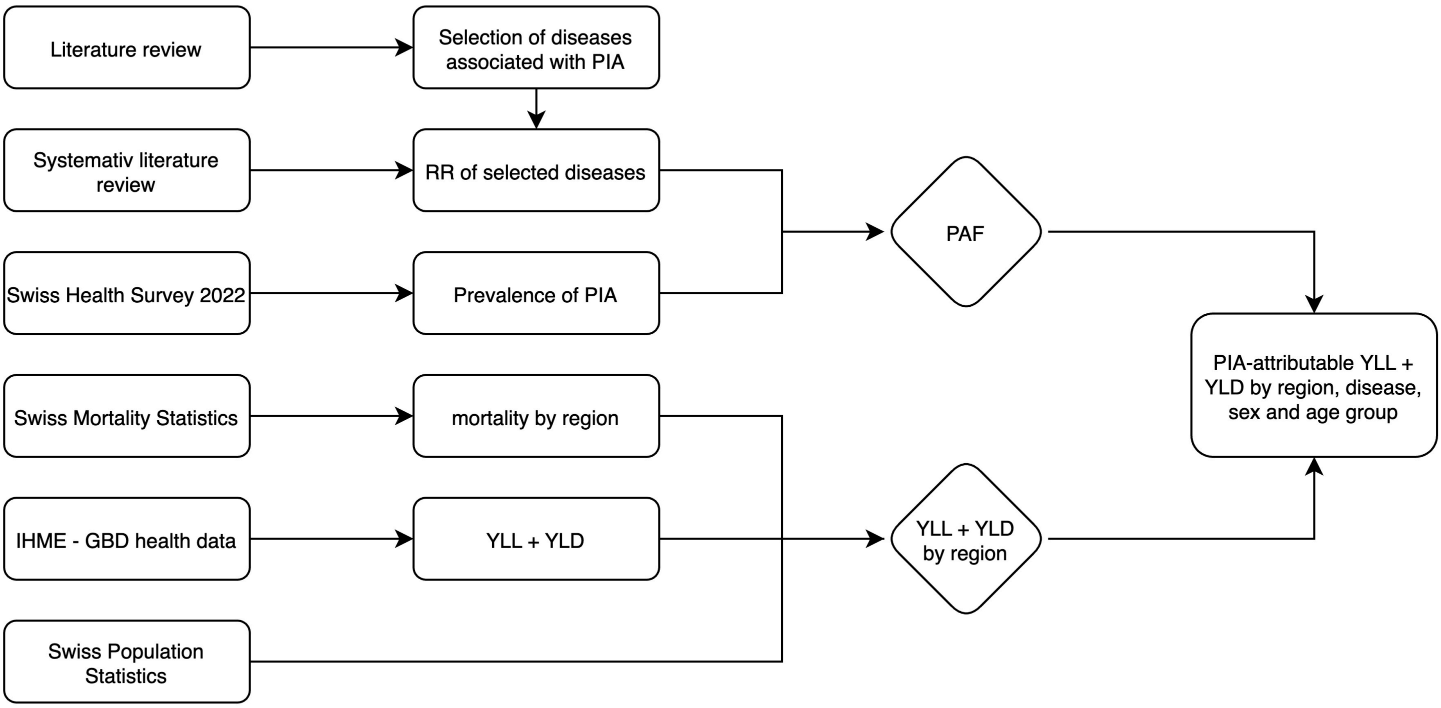

Figure 1: Methodological approach. GBD: Global Burden of Disease; IHME: Institute of Health Metrics; PAF: Population attributable fraction; YLD: Years lived with disability; YLL: Years of life lost.

Selection of diseases

Physical inactivity-related diseases were identified through a comprehensive literature search. The selection process was based on the WHO's Global Action Plan on Physical Activity 2018–2030 (GAPPA) [21]. Findings were cross-referenced and supplemented with recent research reports that provided updated insights into the impacts of physical inactivity on population health outcomes [8, 22, 23].

Second, inclusion of diseases required the availability of RR estimates derived from large-scale meta-analyses. Only diseases with quantifiable and robust associations with physical inactivity were considered eligible for inclusion.

Third, inclusion of diseases further required the availability of YLD and YLL estimates for Switzerland. Importantly, the estimation of RR as well as YLD and YLL had to be based on the same disease definitions, aligned with the International Classification of Diseases, 10th Revision (ICD-10).

Risk ratios

For each selected disease, RRs were identified through a systematic literature search conducted in PubMed. Table S1 in the appendix depicts the full search strategy. Reports published to 7 February 2025 were considered. The search was based on the PECO framework, where P (Population) refers to the general population, E (Exposure) denotes physical inactivity, C (Comparator) denotes meeting physical activity guidelines and O (Outcome) refers to the incidence of the corresponding disease. Meta-analyses including large longitudinal studies meeting this PECO were included. If multiple meta-analyses were identified per disease, one meta-analysis was selected using this hierarchy:

1. Quality of primary studies.
2. Generalisability to the Swiss population.
3. Recency.

As the aim of this study was to derive summary RR estimates for modelling purposes, a formal risk of bias assessment was not conducted. Instead, study quality was addressed indirectly through this predefined selection hierarchy.

RRs and their confidence intervals (CI) were extracted from meta-analyses. If physical activity was considered a protective factor in the studies, the values were adjusted in line with the research question (physical inactivity as the exposure) by calculating the reciprocal values. Confounding was considered at the level of the original studies included in the selected meta-analyses, which typically report adjusted effect estimates. For the models, we assumed constant RRs across language regions, age and sex groups.

Prevalence of physical inactivity

Age-, sex- and language specific prevalence data for physical inactivity were obtained from the Swiss Health Survey conducted in 2022. The Swiss Health Survey categorises physical activity into four levels [24, 25]:

- Inactive: Less than 30 minutes of moderate physical activity or less than once per week of intense physical activity.
- Partially active: 30–149 minutes of moderate physical activity or once per week of intense physical activity.
- Sufficiently active: At least 150 minutes of moderate physical activity or twice per week of intense physical activity.
- Trained: At least three times per week of intense physical activity.

Moderate-intensity physical activity corresponds to 3–6 METs and vigorous-intensity physical activity to >6 METs [3]. To enhance comparability of the results with related research in this field and to ensure consistent interpretation of RRs, physical activity was dichotomised as “physically inactive” (inactive, partially active) or “physically active” (sufficiently active, trained).

Population Attributable Fraction

The Population Attributable Fraction was estimated from RR values and prevalence data, stratified by disease, region, age and sex. Levin’s formula was applied, assuming constant RRs across regions, age and sex [26]:

$$\mathrm{PAF} = \frac{P^{*}(\mathrm{RR}-1)}{P^{*}(\mathrm{RR}-1)+1}$$

where:

P: Prevalence of physical inactivity in the population,

RR: Relative risk for the health event associated with the risk factor.

Levin's formula, widely used in epidemiology, estimates the proportion of cases attributable to a risk factor by combining association strength (RR) with exposure prevalence (P), making it suitable for assessing the physical inactivity-attributable burden of disease [26].

Definition of language regions

The Federal Statistical Office of Switzerland provides data by canton rather than language region. We therefore assigned cantons to language regions based on language, using the Swiss Statistical Atlas [27-30]. Multilingual cantons were classified according to their predominant language.

YLD and YLL

Disease-, age- and sex-specific YLD and YLL were derived from GBD for 2022 for Switzerland. As regional estimates are unavailable, YLD and YLL data were then distributed across language regions using standardised weights: For each disease-age-sex group, the distribution was calculated by weighting the number of disease-specific deaths in each region at 20% and the corresponding population at 80%.

Physical inactivity-attributable YLD and YLL

To estimate region-disease-age- and sex-specific attributable YLD and YLL, the corresponding Population Attributable Fraction and outcome were multiplied. The 95% CI values were calculated using parametric bootstrapping with 5000 iterations. For YLD, YLL and RR values, a log-normal distribution was used and for prevalences, a beta distribution was applied. To enhance the comparability of the results, rates per 100,000 (aged >20 years) were calculated. All analyses were performed using RStudio version 2026.01.1+403 [31].

A sensitivity analysis was conducted to assess the robustness of the regional weighting approach. In addition to the primary weighting scheme (80% population, 20% mortality), alternative weighting scenarios were applied. For each scenario, regional YLD and YLL rates were recalculated and compared across regions (table S9 in the appendix).

Code availability

The analytical code used for data processing and modelling is available in the appendix. All relevant references, including those related to the code, are provided in the technical appendix. The R code of this study is available in the appendices.

Results

Selected diseases and RR

The systematic search identified 2181 entries. After removing duplicates, 1395 reports remained for title and abstract screening. One additional study was added by handsearch. A total of 93 full texts were reviewed, some reporting on multiple diseases. Studies by Kyu et al. [46], Alzahrani et al. [47], Iso-Markku et al. [48], Pearce et al. [37] and Garcia et al. [49] were included (figure 2). Table 1 depicts disease-specific RRs, ICD codes, the source as well as the number of studies included in each meta-analysis.

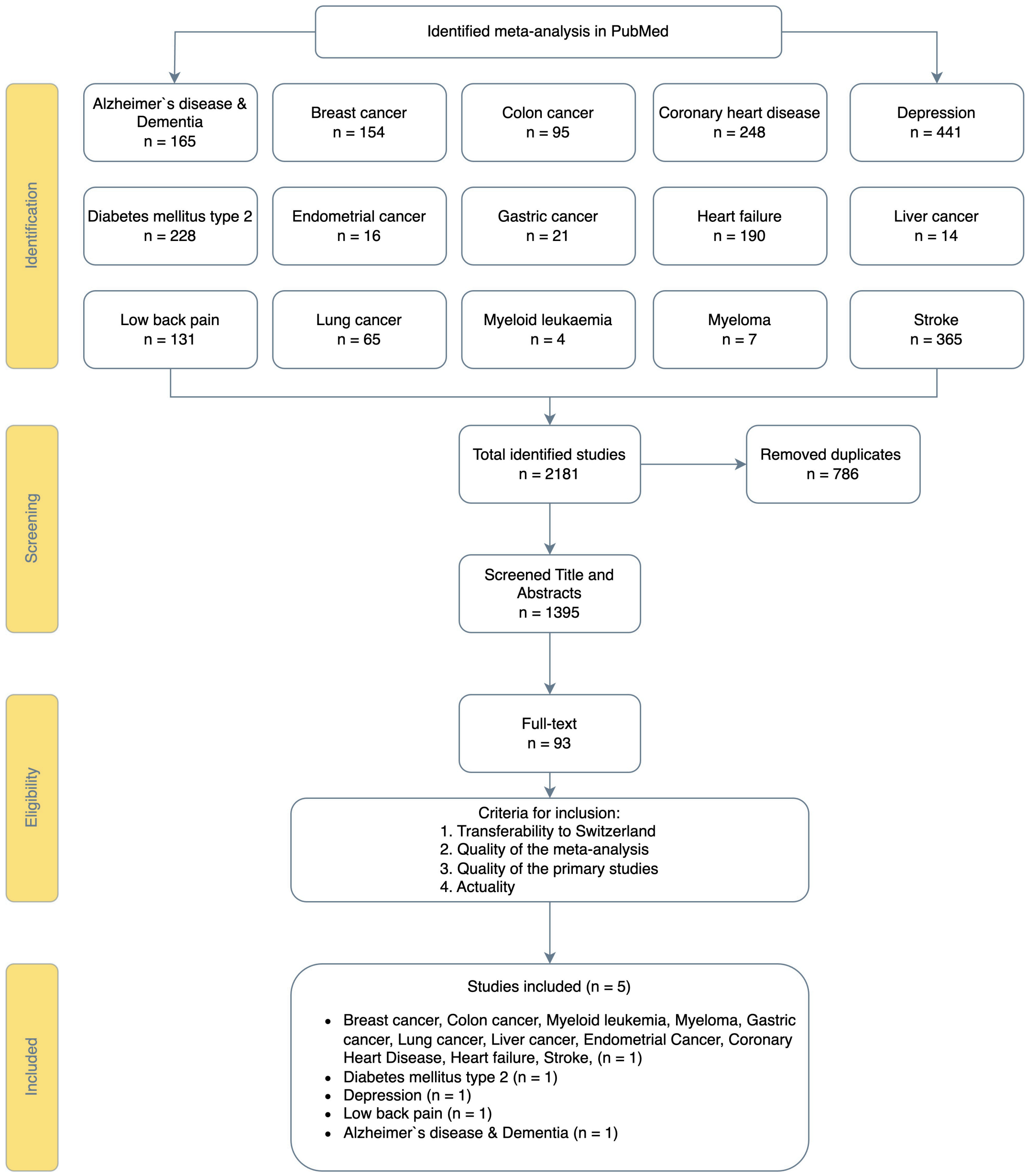

Figure 2: PRISMA flow diagram.

The included studies covered a broad range of disease outcomes, for which pooled RRs were extracted from the identified meta-analyses. These outcomes and their corresponding data sources are summarised in table 1.

Table 1: Risk ratios.

Disease	ICD-10 code	Risk ratio	95% CI, lower bound	95% CI, upper bound	Number of studies	Source
Alzheimer's disease and dementia	F00–F02.0, F02.8–F03.9, G30–G31.1, G31.8–G31.9	1.24	1.16	1.33	20	Iso-Markku et al. [48]
Breast cancer	C50–C50.9, D05–D05.9, D24–D24.9, D48.6, D49.3	1.05	1.03	1.09	29	Garcia et al. [49]
Colon cancer	C18–C21.9, D01.0–D01.3, D12–D12.9, D37.3–D37.5	1.08	1.01	1.15	20	Garcia et al. [49]
Coronary heart disease	I20–I25.9	1.27	1.19	1.35	26	Garcia et al. [49]
Depression	F32–F33.9, F34.1	1.33	1.22	1.47	15	Pearce et al. [37]
Diabetes mellitus type 2	E10–E10.1, E10.3–E11.1, E11.3–E11.9, P70.2	1.17	1.11	1.23	55	Kyu et al. [49]
Endometrial cancer	C54–C54.9, D07.0–D07.2, D26.1–D26.9	1.11	1.03	1.19	13	Garcia et al. [49]
Gastric cancer	C16–C16.9, D00.2, D13.1, D37.1	1.28	1.10	1.52	5	Garcia et al. [49]
Heart failure	I11–I11.2, I11.9	1.19	1.08	1.33	11	Garcia et al. [49]
Liver cancer	C22–C22.8, D13.4	1.19	1.04	1.37	6	Garcia et al. [49]
Low back pain	G54.4, M47.015–M47.019, M47.15–M47.18, M47.25–M47.28, M47.815–M47.818, M47.896–M47.899, M48.05–M48.08, M48.16–M48.19, M48.25–M48.27, M48.35–M48.38, M48.45–M48.48, M48.55–M48.58, M49.85–M49.88, M51.05–M51.07, M51.15–M51.17, M51.25–M51.27, M51.35–M51.37, M51.45–M51.47, M51.85–M51.87, M53.3, M53.85–M53.88, M54.05–M54.09, M54.15–M54.18, M54.3–M54.5, M99.03–M99.04, M99.13–M99.14, M99.23–M99.24, M99.33–M99.34, M99.43–M99.44, M99.53–M99.54, M99.63–M99.64, M99.73–M99.74, M99.83–M99.84	1.11	1.04	1.18	7	Alzahrani et al. [47]
Lung cancer	C33–C34.9, D02.1–D02.3, D14.2–D14.3, D38.1	1.19	1.14	1.23	16	Garcia et al. [49]
Myeloid leukaemia	C91–C91.0, C91.2–C91.3, C91.6, C92–C92.6, C93–C93.1, C93.3, C93.8, C94–C94.5, C94.7–C95.9	1.33	1.05	1.67	4	Garcia et al. [49]
Myeloma	C88–C90.9	1.33	1.09	1.64	4	Garcia et al. [49]
Stroke	G45–G46.8, I60–I63.9, I65–I66.9, I67.0–I67.3, I67.5–I67.6, I68.1–I68.2, I69.0–I69.3	1.25	1.18	1.33	25	Garcia et al. [49]

Prevalence data for physical inactivity

Prevalence of physical inactivity varied across language regions, sex and age groups. Overall, prevalence was consistently higher among women than men in all regions. Sex differences tended to widen with increasing age, with the largest gaps observed in older adults. While regional differences were present, the general pattern of higher prevalence among women and increasing sex gaps with age was consistent across all language regions.

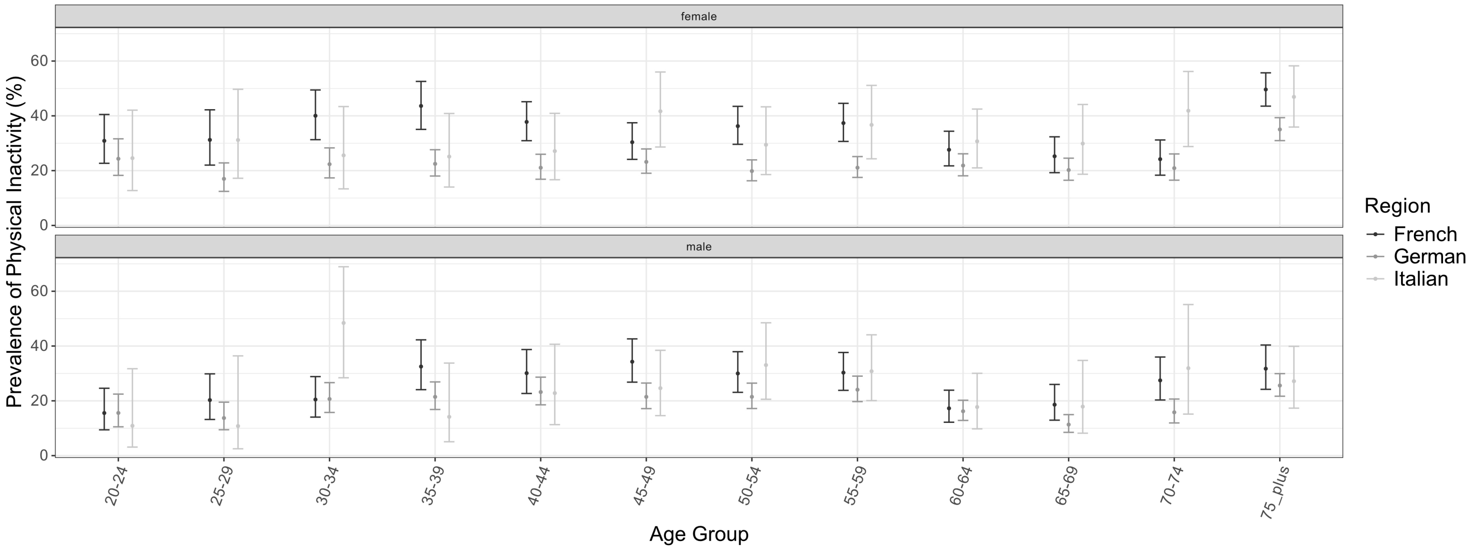

Figure 3: Prevalence of physical inactivity by language regions and age groups. Values are shown as percentages. Error bars represent 95% confidence intervals.

Population Attributable Fraction

Across all region, disease, sex and age groups, the average Population Attributable Fraction was 0.05. Tables S2 and S3 in the appendix show region-disease-sex- and age-specific Population Attributable Fractions. These Population Attributable Fractions ranged from 0.008 (95% CI: 0.00–0.04) (Italian-speaking men aged 25–29 for colon cancer) to 0.14 (95% CI: 0.03–0.25) (French-speaking women aged >75 for leukaemia).

Physical inactivity-attributable YLD and YLL

All rates are presented per 100,000 people aged over 20 years. The overall physical inactivity-attributable burden of disease for Switzerland in 2022 is summarised in table 2, including YLD, YLL and DALY rates as well as corresponding absolute numbers.

Region-, disease- and sex-specific physical inactivity-attributable YLD and YLL rates are provided in the appendix (tables S4, S7 and S8).

Table 2: Physical inactivity-attributable rates per 100,000 people (aged >20 years) and absolute numbers in Switzerland. DALY: disability-adjusted life years; YLD: years lived with disability; YLL: years of life lost.

		Rate	**95% CI, lower bound**	**95% CI, upper bound**	**Number**	**95% CI, lower bound**	**95% CI, upper bound**
YLD	French	130.72	120.78	141.5	5347.76	4940.86	5788.63
	German	96.26	88.81	104.01	9813.32	9053.49	10,603.06
	Italian	134.9	122.04	148.25	871.26	788.21	957.47
	All regions	227.08	214.74	240.08	16,032.34	15,160.78	16,950.17
YLL	French	221.56	192.54	264.55	9063.70	7876.79	10,822.60
	German	186.67	162.64	222.27	19,029.34	16,579.65	22,658.19
	Italian	287.74	245.82	349.99	1858.39	1587.62	2260.45
	All regions	424.23	383.15	479.23	29,951.43	27,051.03	33,834.31
DALY	All regions	651.31	605.72	709.45	45,983.78	42,211.81	50,784.48

Region-specific outcomes

Region-specific patterns are presented in table 2. Overall, the physical inactivity-attributable burden of disease was consistently higher in the Italian- and French-speaking regions compared with the German-speaking region. This pattern was observed for both YLD and YLL. While differences between regions were moderate for YLD, they were more pronounced for YLL, with the highest rates observed in the Italian-speaking region.

Disease-specific outcomes

Figure 4 depicts region-, disease- and sex-specific YLD and YLL rates per 100,000 attributable to physical inactivity. Across outcomes, a consistent regional pattern was observed, with higher rates in the Italian- and French-speaking regions compared with the German-speaking region. For YLD, rates per 100,000 people were generally higher among women than men, whereas sex differences in YLL were less pronounced.

As shown in figure S4 and table S5 in the appendix, depression and low back pain were the leading contributors to physical inactivity-attributable YLD rates, followed by Alzheimer's disease and dementia, type 2 diabetes, stroke and coronary heart disease.

Across regions and sex groups, variability in YLD rates was most evident for low back pain, Alzheimer's disease and dementia, type 2 diabetes, stroke and coronary heart disease (table S7 in the appendix). Alzheimer's disease and dementia showed higher rates among women in all language regions, while type 2 diabetes displayed similar YLD levels between sexes. Cancer-related physical inactivity-attributable YLD rates were generally low across regions.

The diseases contributing most to physical inactivity-attributable YLL rates were coronary heart disease, Alzheimer's disease and dementia, stroke, lung cancer and heart failure. Disease-specific physical inactivity-attributable YLL rates are presented in more detail in table S8 in the appendix.

Coronary heart disease showed the highest overall YLL rates, with a relatively balanced sex distribution; female rates were approximately 0.86 to 0.94 times those of males across regions. In the Italian-speaking region, coronary heart disease-related YLL levels were about 1.5 to 1.6 times higher than in the German- and French-speaking regions (table S8).

Most cancers were associated with comparatively low YLL rates. Nevertheless, sex-specific patterns were evident, with higher YLL rates for breast cancer among women and slightly elevated YLL for lung cancer among men.

Overall, YLL rates attributable to physical inactivity were mainly associated with cardiovascular and neurodegenerative diseases, particularly coronary heart disease, stroke, and Alzheimer's disease and dementia (figure S4, table S8 in the appendix).

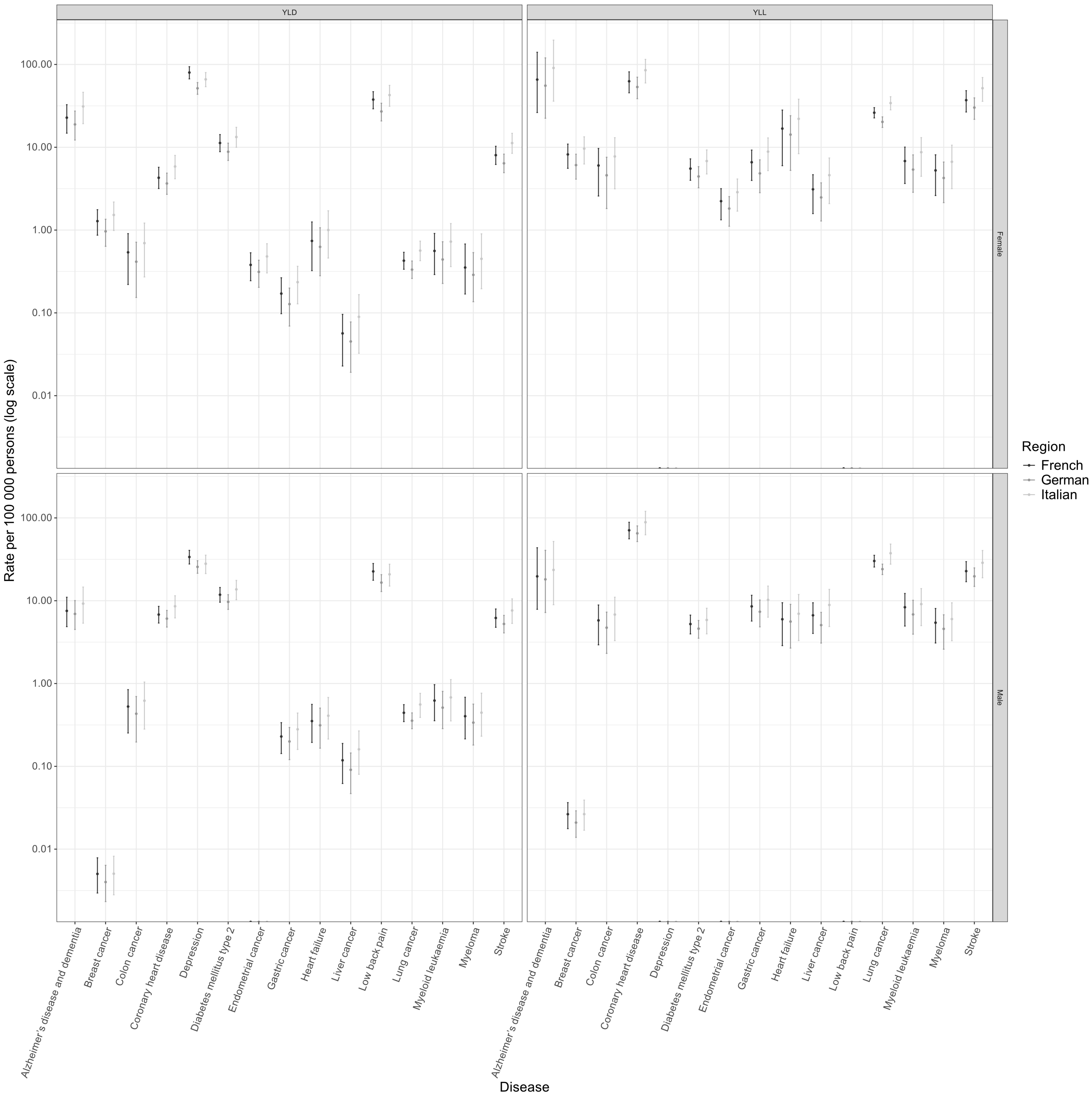

Figure 4: Physical inactivity-attributable rates for YLD (Years lived with disability) and YLL (Years of life lost) by disease and sex. Points represent rates per 100,000 people (aged >20 years). Error bars indicate 95% confidence intervals. The y-axis is displayed on a logarithmic scale.

Sex-specific outcomes

Sex-specific rates of physical inactivity-attributable burden of disease are shown in table 3. Across regions, YLD rates were consistently higher among women than men, with the largest differences observed in the Italian- and French-speaking regions.

Regional patterns were similar for YLL rates, although sex differences were less pronounced. In all regions, YLL rates remained higher in women than in men, but the magnitude of these differences was smaller compared with YLD rates.

Overall, both YLD and YLL rates followed a consistent regional gradient, with higher rates in the Italian- and French-speaking regions compared with the German-speaking region.

Table 3: Region- and sex-specific physical inactivity-attributable YLD (Years lived with disability) and YLL (Years of life lost) rates per 100,000 people (aged >20 years).

		Rate for females	95% CI, lower bound	95% CI, upper bound	Rate for males	95% CI, lower bound	95% CI, upper bound
YLD	French	168.46	150.45	187.1	91.43	82.11	101.19
	German	119.87	107.31	133.83	72.37	65.58	79.65
	Italian	176.12	154.41	199.48	91.04	79.82	103.44
YLL	French	252.22	203.22	331.15	189.63	165.48	220.56
	German	207.33	166.62	273.43	165.76	145.25	192.87
	Italian	339.96	269.74	454.28	232.17	194.21	276.25

Sensitivity analyses showed minimal variation in rates across weighting scenarios, particularly for YLL rates, while the relative differences between regions remained consistent (table S9 in the appendix).

Discussion

This study demonstrates a substantial burden of disease of physical inactivity on health in Switzerland, with pronounced disparities between language regions and sexes. The Italian-speaking population consistently exhibited the highest YLD and YLL rates, followed by the French-speaking region, whereas the German-speaking region showed the lowest burden of disease.

An important step towards assessing the robustness of the estimates found in this study is comparison with findings from comparable studies. Although methodological heterogeneity across studies, such as differences in disease selection and model assumptions, limits direct comparability, these comparisons nevertheless provide useful context regarding the plausibility of our results.

In the present analysis, we estimated 45,983.78 (95% CI: 42,211.81–50,784.48) DALYs attributable to physical inactivity. This figure aligns closely with the estimate reported in a similar study conducted in 2019, which quantified 40,433 physical inactivity–attributable DALYs. The moderate increase observed in the present results can be plausibly explained by population growth, increase in the prevalence of included conditions, and the broader set of diseases incorporated in the present study. Importantly, the regional and sex-specific patterns we observed were consistent with those reported in the 2019 analysis, further supporting the validity of our findings [17].

A more recent study reported a higher estimate of 52,689 DALYs attributable to physical inactivity [6]. Unlike our approach, which applied disease-specific RRs, the authors of that study used an aggregated RR for all cancer types and all cardiovascular diseases. Such aggregation likely inflates attributable burden of disease estimates, as also reflected in their substantially higher estimates of attributable mortality when comparing aggregated versus disaggregated analyses.

The magnitude of the physical inactivity-attributable burden of disease observed in this study is consistent with estimates from the 2019 GBD study. In 2022, physical inactivity was estimated to account for approximately 2% of total DALYs (45,984 DALYs) in Switzerland. This is broadly in line with GBD estimates from 2019, which suggest that physical inactivity accounts for approximately 0.5–1% of total DALYs globally, indicating that the Swiss estimates are of comparable magnitude. While comparable estimates are available through the GBD study, directly comparable country-specific studies using similar methodological approaches remain limited. Nevertheless, previous international analyses indicate that the burden of disease associated with physical inactivity tends to be higher in high-income countries and in high-income Western regions, supporting the interpretation that the Swiss estimates are plausible within a high-income setting. However, comparisons should be interpreted with caution due to differences in study design, population structure and disease inclusion [19, 23, 32].

In comparison, other major risk factors contribute substantially more to the overall burden of disease. For example, smoking has been estimated to account for approximately 10% of total DALYs (208,999 DALYs) in Switzerland, while overweight and obesity contribute around 6% (approximately 150,000 DALYs). Although these estimates are derived from different years and are not directly comparable, they provide a useful benchmark to contextualise the relative magnitude of the physical inactivity-attributable burden of disease [33, 34].

Sex-specific analyses further revealed that women experienced higher YLD and YLL rates than men across all regions. While these sex differences were consistent, they were less pronounced than the regional contrasts, underscoring the importance of structural and environmental determinants beyond individual-level differences. Comparable findings have been reported in Germany, where women also bear a higher burden of disease attributable to physical inactivity [35, 36]. A key driver of these disparities is the higher prevalence of physical inactivity among women, which directly translates into greater physical inactivity-attributable YLD and YLL rates. Another important aspect is that women consistently exhibit higher YLD values than men [19]. Depression contributed substantially to the female YLD rate, particularly in the French-speaking region, reflecting well-documented sex disparities in mental health and participation in physical activity [37]. For YLL, sex differences were less pronounced and varied by disease, with women showing higher losses for conditions such as Alzheimer's disease and dementia. Biological susceptibility, health-seeking behaviour and sex norms may partly explain these differences [38].

Regional disparities were the most striking feature of the analysis. In the Italian- and French-speaking regions, physical inactivity-attributable YLD rates were approximately 1.40 and 1.36 times higher, respectively, than in the German-speaking region (96.26; 95% CI: 88.81–104.01). Differences between the Italian-speaking (130.72; 95% CI: 120.78–141.50) and French-speaking (130.72; 95% CI: 120.78–141.50) regions were smaller, indicating a broadly similar burden of disease across these regions. Similarly, for physical inactivity-attributable YLL rates, the Italian-speaking region consistently bore the greatest burden of disease, with rates around 287.74 (95% CI: 245.82–349.99), compared to 221.56 (95% CI: 192.54–264.55) in the French-speaking region and 186.67 (95% CI: 162.64–222.27) in the German-speaking region. This corresponds to approximately a 1.2-fold higher YLL rate in the French-speaking region and a 1.5-fold higher rate in the Italian-speaking region compared with the German-speaking region. Differences in YLD and YLL rates between the different language regions may reflect cultural norms, socioeconomic environments or differences in the built environment and infrastructure that facilitate or hinder physical activity, as suggested in prior international analyses [38, 39]. For example, comparative European studies have shown that populations in Southern Europe report lower levels of leisure-time physical activity and active transport than those in Central and Northern Europe. These observed patterns are often attributed to differences in urban infrastructure, transport systems and cultural norms around sport participation [39-41]. Such contextual factors may partly explain why the Italian-speaking region consistently exhibited the highest burden of disease, whereas the German-speaking region showed the lowest burden of disease of physical inactivity on health outcomes in Switzerland.

Cultural and linguistic factors, lifestyle habits and lower levels of active transport may amplify this burden of disease. Further, demographic and behavioural aspects, differences in infrastructure for physical activity, regional health promotion policies and socioeconomic conditions may also contribute. For instance, transport data suggest German-speaking populations in Switzerland engage more frequently in walking than French- and Italian-speaking populations [42]. Socioeconomic disparities may additionally influence access to resources, health attitudes and use of health services, thereby shaping both physical inactivity prevalence and management of associated diseases, as reflected in higher mortality risks at lower socioeconomic status [43] and greater regional deprivation in French-speaking cantons [44].

Although recent studies suggest overall low levels of physical inactivity in Switzerland in the international context [45], socioeconomic differences across language regions may affect access to resources, health attitudes and health service use. Such disparities could influence both the prevalence of physical inactivity and the recognition or management of associated diseases. Taken together, these contextual and system-level factors likely contribute to the observed regional variation in physical inactivity-related burden on morbidity and mortality in Switzerland.

The prominent regional disparities highlight the importance of regionally adapted strategies for physical activity promotion. Efforts should prioritise the Italian- and French-speaking regions, where both demographic ageing and contextual factors likely intensify physical inactivity-related burden of disease. Sex-specific interventions, particularly addressing barriers to physical activity among older women, remain important but should be framed within the broader context of regional inequalities. Reducing physical inactivity could yield substantial gains in health and lower long-term healthcare expenditures, as YLD is a key driver of direct and indirect costs in people with chronic diseases [9, 10].

Strengths of this study include the use of harmonised GBD-based methods, national data sources, age and sex stratification, thorough and stringent systematic literature search, and bootstrapping statistical techniques to access uncertainty of the results, as well as the consistent use of ICD codes across GBD, mortality statistics and risk estimates, which homogenises the process.

Limitations of this present study comprise reliance on self-reported measures of physical activity as well as assumptions in mapping of the regional burden of disease. Furthermore, the analysis applied uniform RRs across all ages, which may underestimate risk in older groups in whom the impact of physical inactivity levels on disease incidence and progression is greatest. This may have distorted the results and may have led to an underestimation of the risk, particularly for older age groups. Misclassification regarding ICD coding of the death statistics may have biased the results.

To distribute national YLD and YLL estimates across language regions, the applied weighting scheme reflects a pragmatic assumption that the regional distribution of burden of disease is primarily driven by population size (80%), while also incorporating mortality patterns (20%). To account for the potential arbitrariness of this assumption, a sensitivity analysis was conducted, demonstrating that the weighting scheme had a negligible impact on the estimated differences between language regions (table S9 in the appendix).

The strictness of the criteria for inclusion of diseases may have led to exclusion of potentially relevant diseases, potentially underestimating the results.

Conclusion

Physical inactivity imposes a substantial burden on morbidity and mortality expressed as YLD and YLL in Switzerland, with pronounced regional differences. People living in the Italian- and French-speaking regions face higher rates as compared to those living in the German-speaking regions. Women, especially older women, consistently carry a higher burden of disease of physical inactivity on health outcomes. These findings highlight the need for region- and sex-specific strategies rather than a “one-size-fits-all” approach.

Policies should be tailored to cultural, linguistic and social contexts and address barriers to physical inactivity among women. Regionally adapted interventions, especially for ageing populations in the Italian- and French-speaking regions, are necessary. Alignment with international frameworks such as WHO GAPPA and the 2030 reduction target will support national efforts to reduce inequalities.

For policymakers, this means developing regionally adapted public health strategies that promote active lifestyles through supportive infrastructure, workplace and school programmes, and community-based initiatives. A coordinated national strategy that accounts for regional and sex differences will be key to reducing preventable morbidity and mortality and fostering healthier, more resilient Swiss communities.

Data sharing statement

This study used secondary data from publicly available and institutional data sources. Mortality and population data were obtained from the Swiss Federal Statistical Office, and burden-of-disease estimates were derived from the Global Burden of Disease Study. Data from the Swiss Health Survey are not publicly available but can be requested from the Swiss Federal Statistical Office. No individual-level participant data were generated or analysed for this study. Further information on the data sources and aggregated analysis outputs is available from the corresponding author upon reasonable request.

Financial disclosure

The authors did not receive any financial support for the preparation of this manuscript.

Potential competing interests

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflict of interest related to the content of this manuscript was disclosed.

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Appendix and Technical appendix

The two PDFs are available for download as a separate files at https://doi.org/10.57187/5162.