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Abdominal, inguinal and femoral hernias in the European Union: a comprehensive analysis using the Global Burden of Disease database

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Purpose: This study aimed to assess trends in the burden of abdominal wall hernias (prevalence, incidence, disability-adjusted life years [DALYs], and mortality) in the European Union (EU) using Global Burden of Disease (GBD) data.

Methods: GBD data for 'inguinal, femoral and abdominal hernias' were extracted for the EU from 1990 through 2023, including counts and age-standardized rates (ASRs) for prevalence, incidence, DALYs, and mortality. Trends were analyzed via Joinpoint regression to estimate annual average percent change (AAPC). Sex- and age-specific estimates were also examined. The same analyses were also conducted across European regions (Western, Central, and Eastern Europe) as a secondary objective.

Results: From 1990 to 2023, ASRs declined significantly for prevalence (AAPC −1.23), incidence (−1.24), DALYs (−1.91), and mortality (−2.18) (all $p < 0.001$). In 2023, male-to-female rate ratios were 2.8 for prevalence, 3.4 for incidence, 2.1 for DALYs, and 1.4 for mortality, which remained stable over the study period. Reductions were most pronounced in individuals ≥50 years. From 1990 to 2023, all geographic European regions showed downward trends in health metrics, consistent with patterns observed in the EU; Western Europe consistently had lower ASR

prevalence and DALYs than Eastern Europe, while Central Europe demonstrated the steepest declines in ASR prevalence, DALYs, and mortality. **Conclusion:** Although mortality and morbidity from abdominal wall hernias have declined in Europe over the past three decades, the burden remains concentrated among older individuals and certain regions, with persistent sex-specific differences in outcomes.

KEYWORDS

abdominal hernia, inguinal hernia, femoral hernia, disability-adjusted life-years, global burden of disease, global health

Introduction

Abdominal wall hernias are among the most common surgical conditions worldwide. Inguinal hernia is the most common subtype [1], accounting for an estimated 140–240 surgical repairs per 100,000 population annually in the European Union (EU) [2]. However, most population-based studies of hernia have been geographically limited to single locations and have lacked long-term longitudinal assessments of disease burden [3–6]. Consequently, comprehensive assessment of temporal trends and direct comparisons of disease burden between countries or regions are often not feasible. This is particularly important for benchmarking health progress across countries, identifying the leading causes of health loss that may be amenable to prevention and intervention, and informing research on health equity [7].

The Global Burden of Disease (GBD) Study was established in the early 1990s to address the need for comprehensive and comparable estimates of population health across diseases, injuries, and risk factors [8, 9]. The GBD provides standardized estimates of mortality and disease burden, including years of life lost (YLLs), years lived with disability (YLDs), and disability-adjusted life years (DALYs), across age groups, sexes, countries, regions, and time periods. The GBD classifies "inguinal, femoral, and abdominal hernia" as a cause within digestive diseases, under the broader category of non-communicable diseases. By systematically incorporating available epidemiological data and regularly updating estimates, this initiative provides a framework for assessing temporal and geographic patterns in hernia burden.

GBD estimates are available across multiple geographic levels, including super-regions, geographic regions, and custom regions such as the European Union (EU). The EU represents a unique setting for evaluating hernia outcomes, combining high surgical capacity and evidence-based care with substantial demographic aging and heterogeneity in healthcare systems. However, despite the availability of multiple hernia registries across Europe [10, 11], there is a paucity of standardized and comparable estimates of the population-level hernia burden. Consequently, the long-term temporal trends and geographic variation in population-level hernia burden across the EU remain insufficiently characterized. GBD thus provides an opportunity to examine whether differences in hernia care and healthcare systems are reflected in population-level disease burden.

Using data from the GBD 2023 study [8, 9], we assessed prevalence, incidence, DALYs, and mortality associated with hernia in the EU. To provide a consistent evaluation of temporal changes, we analyzed trends over a 33-year period and conducted sex-stratified analyses to explore differences between males and females. The same analyses were also conducted separately for Western, Central, and Eastern Europe, encompassing 44 countries.

Materials and methods

Data sources

We used data from the 2023 GBD study conducted by the Institute for Health Metrics and Evaluation (IHME). The GBD study compiles data from multiple sources, including administrative databases, censuses, disease registries, surveys, environmental monitoring systems, demographic surveillance, and vital registration systems (government registries of vital events such as births and deaths), to produce standardized and comparable epidemiological estimates of diseases, injuries, and risk factors across countries and over time. The detailed methodology and statistical framework used to generate estimates for GBD 2023 data has been described elsewhere [8, 9].

We used the GBD cause category "inguinal, femoral and abdominal hernia," which corresponds to ICD-10 codes K40, K41, K42, K44, K45, and K46 [12]. Counts and age-specific rates, expressed per 100,000 population within each age group, were extracted for the following age groups: <1 year, 12–23 months, 2–4 years, and 5-year age groups thereafter up to ≥95 years, as well as age-standardized rates (ASRs) per 100,000 population for prevalence, incidence, DALYs, and mortality. The alternative age groups that were also analyzed were 0–14, 15–49, 50–69, and ≥70 years. The GBD study calculates age-standardized rates by applying age-specific rates to a standard reference population age structure (the GBD world standard population), thereby enabling comparisons across countries and over time independent of differences in population age distributions. We included data from the EU and all 44 countries classified within the GBD European regions of Western Europe, Central Europe, and Eastern Europe.

Outcomes measures

In the GBD framework, hernia estimates were derived from multiple country-level data sources and modeled using standardized GBD methods. For non-fatal outcomes (e.g., YLDs), hospital discharge records, administrative claims, disease registries, and survey data were used and synthesized through the DisMod-MR 2.1 meta-regression model. Cause-specific mortality estimates (deaths due to inguinal, femoral and abdominal hernias) were

based on vital registration data (and verbal autopsy data in some low resource locations) and modeled using the Cause of Death Ensemble model. As part of the modelling framework, the GBD also incorporates population-level risk and sociodemographic factors, including smoking exposure, mean body mass index, Healthcare Access and Quality Index, Sociodemographic Index, education, and income, to improve estimate accuracy. A detailed description of these approaches for hernia estimates are provided in the GBD methodological documents "Cause of Death Estimation" and "Nonfatal Health Outcome Estimation" (See Supplementary Material).

All epidemiological estimates were generated by the GBD study using standard analytical methods. DALYs quantify the number of healthy years of life lost due to a disease, either through premature death or living with disability (i.e., the sum of YLDs and YLLs). YLLs were estimated by multiplying the counts of deaths by the standard life expectancy at the age of death according to the GBD reference life table. YLDs were calculated as prevalence multiplied by a disability weight, reflecting the severity of health loss on a scale from 0 (perfect health) to 1 (death). For hernia, disability weights are primarily based on pain and nausea and their impact on daily activities, with values of 0 for asymptomatic disease, 0.011 for mild, 0.114 for moderate, and 0.324 for severe disease.

Statistical analysis

We used the Joinpoint regression software to characterize the trends and calculate the average annual percent change (AAPC) and 95% confidence intervals (CIs) in age-standardized incidence, prevalence, DALY, and mortality rates [13]. All GBD-derived estimates, including rates and counts, are presented with 95% uncertainty intervals (UIs) provided by the IHME, which incorporate uncertainty from model choices, sampling variability, and data quality. Joinpoint identifies the optimal number of time points (i.e., joinpoints) where the trend considerably changes, measures the annual percent change between joinpoints and returns significance levels. Python software (version 3.13.5) was used for plotting the figures; the following libraries were used: NumPy, Pandas, Matplotlib, and Statsmodels. The aforementioned metrics were also plotted using color intensity based on geographic identifiers (i.e., region or country name) on a choropleth map generated with Folium (version 0.14.0).

Results

Burden of hernias in the EU

In 2023, the total count for prevalence, incidence, DALYs and mortality (deaths) in the EU was 958,168, 677,596, 133,452 and 5,148, respectively. This order was also mirrored in the corresponding ASRs for prevalence (163.61), incidence (128.75), DALYs (18.07) and mortality (0.43) per 100,000 people. A significant downward trend was observed for all the ASRs (in both sexes combined) from 1990 through 2023 ($p < 0.001$); AAPC for ASR prevalence, ASR incidence, ASR DALYs, and ASR mortality was −1.23 (95% CI: −1.24 to −1.21), −1.24 (95% CI: −1.26 to −1.22), −1.91 (95% CI: −1.95 to −1.88), and −2.18 (95% CI: −2.26 to −2.09), respectively. Likewise, calculated AAPCs showed a downward trend for both males and females in terms of prevalence (−1.34 and −1.27), incidence (−1.44 and −0.97), DALYs (−1.98 and −2.02) and mortality (−2.49 and −2.03, respectively). Changes in these metrics over the course of 33 years are visualized in Figure 1. In 2023, males were more affected than females in terms of prevalence (male-to-female ASR ratio of about 2.8), incidence (3.4) and DALYs (2.1), whereas the gender gap was narrower regarding the mortality rate (1.4). These ratios have been relatively consistent over time (Figure 2).

Trends in the EU by age group

In 2023, the highest count for prevalence and incidence in the EU was observed in the 55–59-year age group (about 111,799 and 75,292, respectively), with male predominance. Among males, prevalence rate increased progressively with age, whereas in females it remained relatively stable across age groups. A bimodal distribution of incidence was observed, with an initial peak in early childhood, corresponding predominantly to congenital hernias, followed by a decline through the 10–14-year age group, and a second peak in middle-aged and elderly individuals. In females, the incidence rate under 5 years of age was higher than in all other age groups. The highest count of DALYs was observed in the 85–89-year age group and amounted to 13,780 years (6,109 in males, and 7,671 in females). The peak count of deaths occurred in 85–89 age group, which equaled 1241 (520 males and 721 females). A consistent increase in both DALY and mortality rates was observed with advancing age. These counts and their corresponding rates, which are dependent on the population's age composition, are visualized in Figure 3. To get a better idea of changes over time, the rates were plotted for the following age groups from 1990 to 2023 for both sexes: 0–14 years, 15–49 years, 50–69 years and 70+ years. The steepest decline in DALYs rate can be attributed to those 70 years of age or older (from 184.72 in 1990 to 95.31 in 2023), and then 50–69 age group (from 61.94 in 1990 to 32.58 in 2023). As shown in Figure 4, these two age groups also appear to contribute the most to reduction in prevalence, incidence and mortality rates.

Trends by region and country

Similar to the EU, the overall ASRs significantly declined in Western, Central and Eastern Europe from 1990–2023 ($p < 0.001$) (Figure 5). The ASR prevalence in Western Europe was lower than either Central or Eastern Europe in all years. ASR incidence has decreased over the years in Western (AAPC: −1.36, 95% CI: −1.38 to −1.33), Central (AAPC: −0.7, 95% CI: −0.72 to −0.68) and Eastern Europe (AAPC: −0.68, 95% CI: −0.73 to −0.64). Central Europe was characterized by a steep decline in ASR mortality (AAPC: −4, 95% CI: −4.13 to −3.87), followed by Western (AAPC: −1.33, 95% CI: −1.43 to −1.22) and Eastern Europe (AAPC: −0.51, 95% CI: −0.69 to −0.33).

From 1990 through 2023, the DALYs count decreased from about 68,661 to 34,221 in Central Europe, and from 82,058 to 66,138 in Eastern Europe, while it remained stable in Western Europe at around 140,000. The ASR DALYs in Western Europe declined from 27.97 to 17.95 (AAPC: −1.32, 95% CI: −1.35 to −1.29), in Central Europe from 53.03 to 22.14 (AAPC: −2.60, 95% CI:

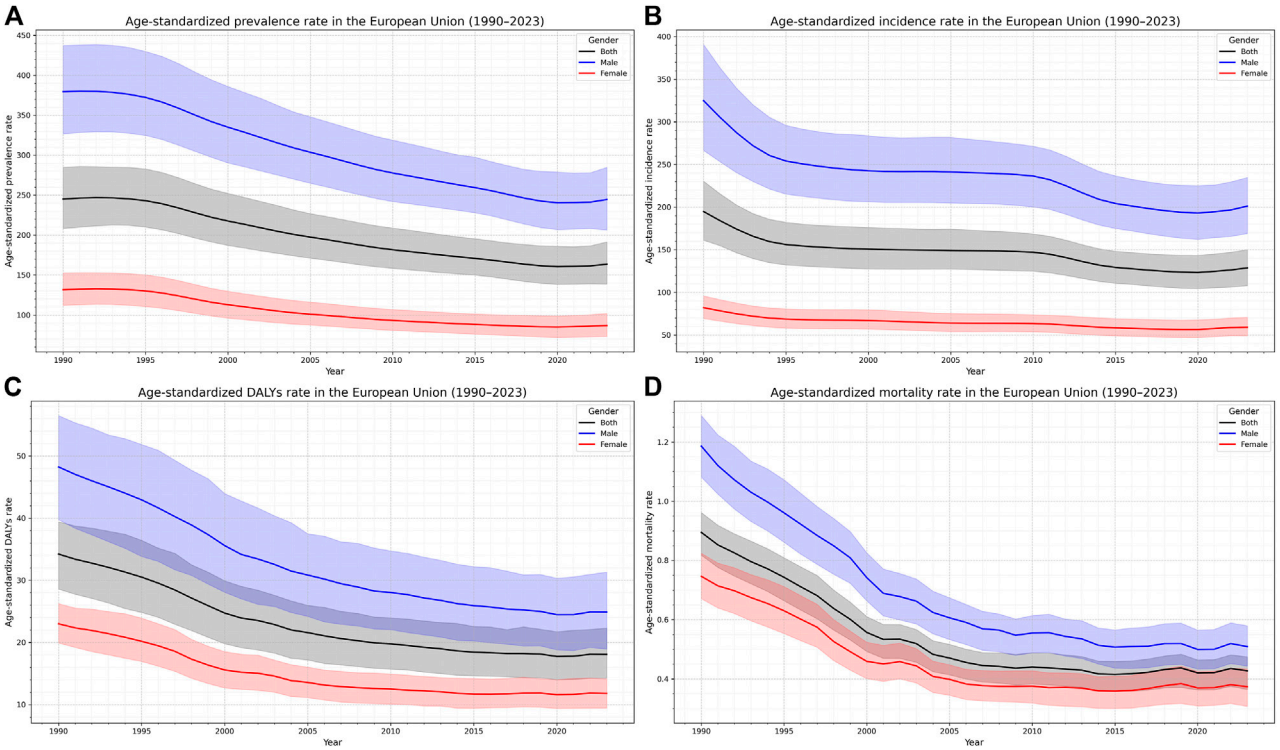


FIGURE 1
Temporal changes in ASR prevalence **(A)**, ASR incidence **(B)**, ASR DALYs **(C)** and ASR mortality **(D)** from 1990 through 2023 in males, females and both sexes. The shaded area corresponds to the 95% uncertainty interval.

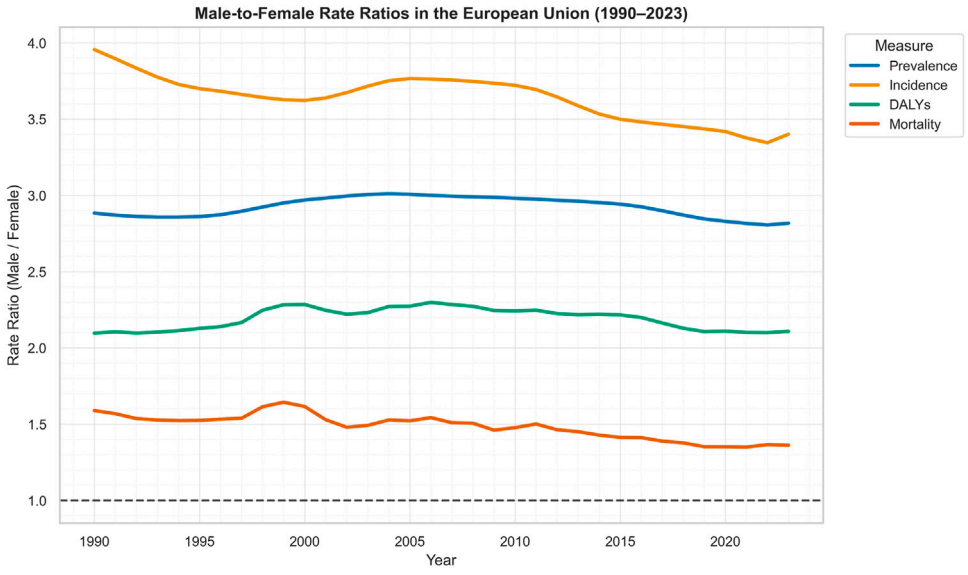


FIGURE 2
Trends for male-to-female rate ratios from 1990 through 2023. DALYs: Disability-adjusted life years.

−2.64 to −2.56), and in Eastern Europe from 35.72 to 24.77 (AAPC: −1.11, 95% CI: −1.18 to −1.04) over the same period. The ASR DALYs was lower in Western Europe compared to Eastern Europe for the whole period between 1990 and 2023. In 2023, the highest ASR DALYs in Western, Central and Eastern Europe was recorded for the United Kingdom (25), Serbia (24.6) and Russia (27.5), respectively, whereas Greece, Montenegro, and Estonia had the lowest ASR DALYs in the aforementioned regions (8.3, 16.6, and

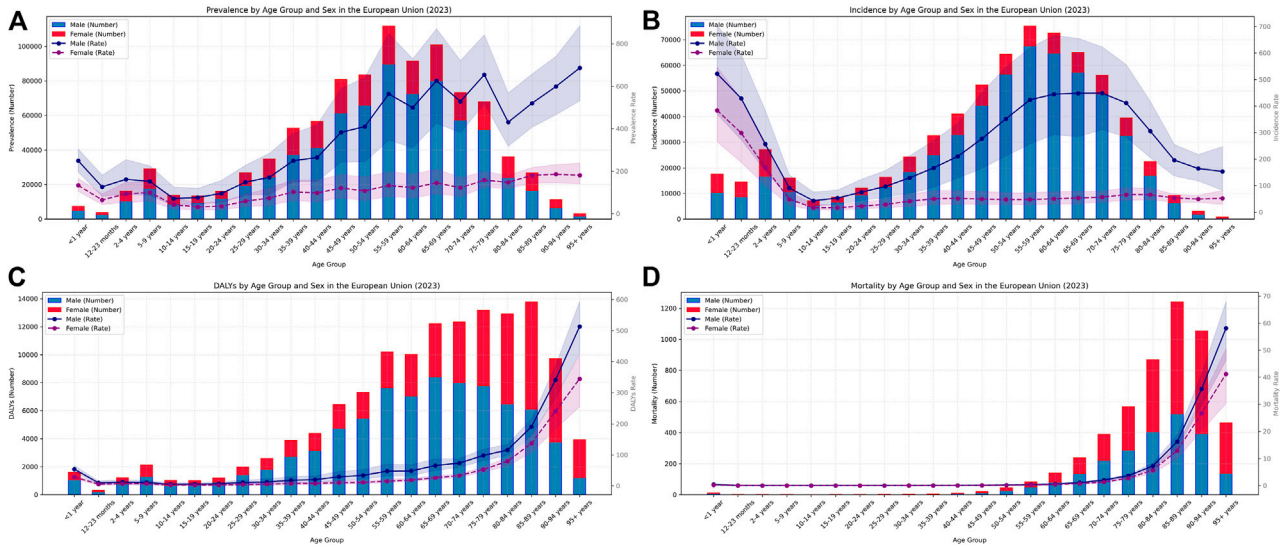


FIGURE 3
Counts and age-specific rates for prevalence **(A)**, incidence **(B)**, DALYs **(C)** and mortality **(D)** for various age groups in males and females in 2023. The shaded area corresponds to the 95% uncertainty interval.

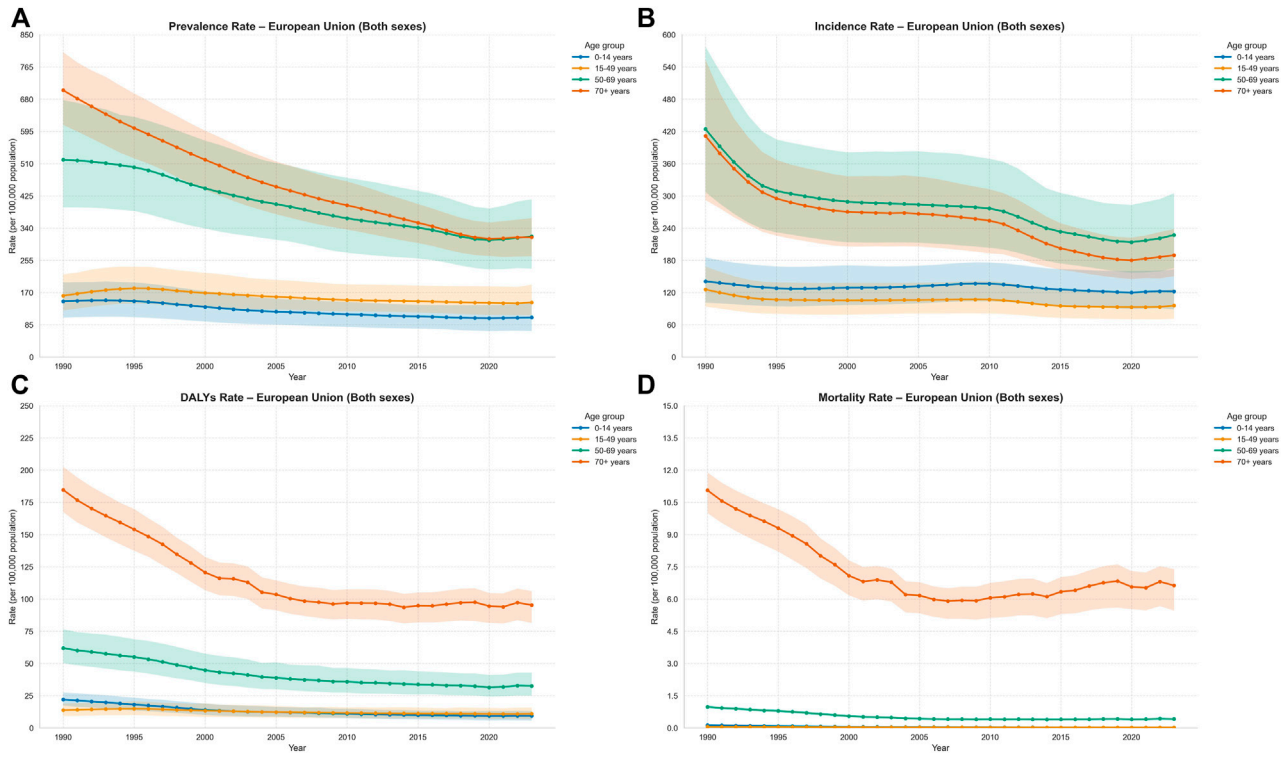


FIGURE 4
Trends for prevalence **(A)**, incidence **(B)**, disability-adjusted life years **(C)** and mortality **(D)** for age groups (both sexes). The shaded area corresponds to the 95% uncertainty interval.

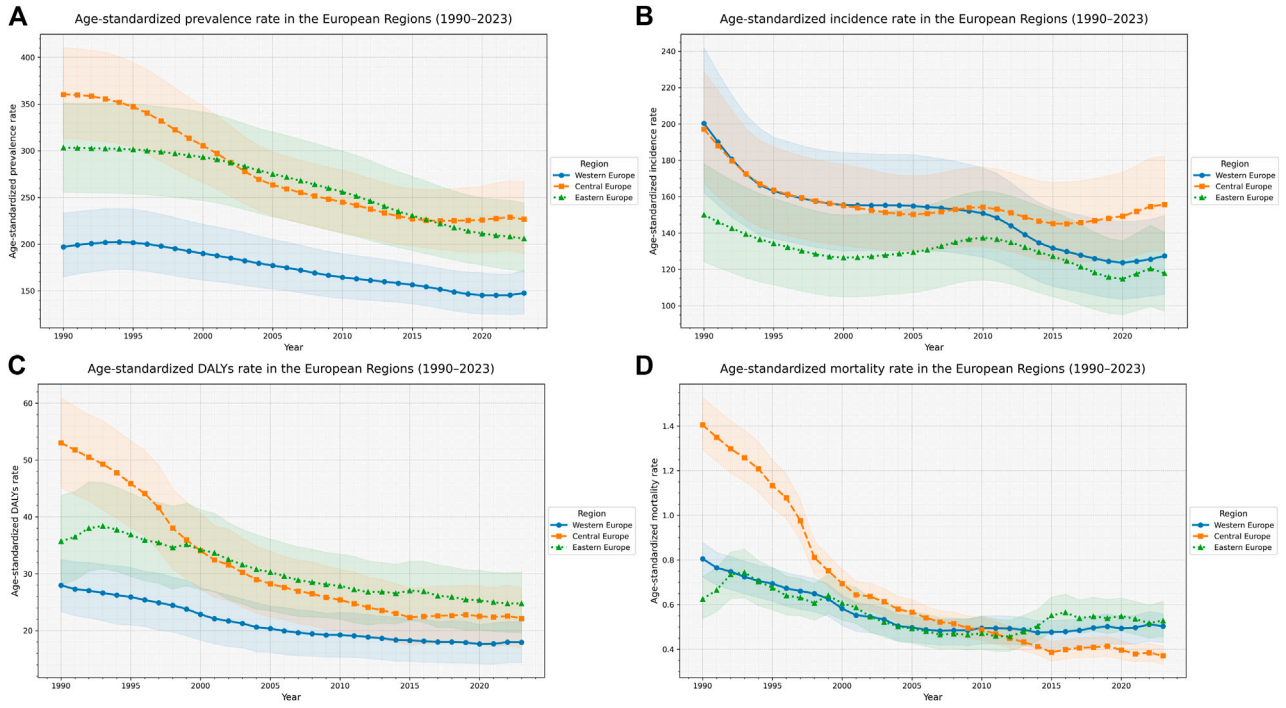


FIGURE 5
Temporal changes in age-standardized rates for prevalence **(A)**, incidence **(B)**, disability-adjusted life years **(C)**, and deaths **(D)** in Western, Central and Eastern Europe from 1990 to 2023. The shaded area corresponds to the 95% uncertainty interval.

16.2, respectively). In these regions, the most pronounced declines in ASR DALYs were observed in Italy (−2.07), Poland (−3.13), and Belarus (−1.72), as shown in Figure 6. Detailed description of the trends for regions and countries is provided in the Supplementary Material (Supplementary Tables S1–S4).

Discussion

The current study summarizes temporal trends and regional differences in prevalence, incidence, DALYs, and deaths associated with inguinal, femoral and abdominal hernias across Europe from 1990 to 2023. Among the hernia types included in the GBD results, inguinal and femoral hernias (collectively referred to as groin hernias), followed by diaphragmatic hernias and umbilical hernias likely contribute the most to the overall disease burden. Given their substantial contribution to the overall burden, the discussion places particular emphasis on groin hernias. Downward trends were noted for ASRs for prevalence, incidence, DALYs, and mortality in the EU and European regions. In particular, morbidity and mortality related to hernia disease have markedly declined over the past three decades, with rates converging across Europe. Prevalence increased with advancing age, consistent with population-based studies [14]. Furthermore, ASR DALYs was substantially greater in men than in women, consistent with previous epidemiological studies and findings from surgical registries [3]. The male-to-female rate ratio was lower for prevalence than for incidence; the gender gap in DALYs and mortality was narrower than that observed for prevalence and incidence. The ASR prevalence of hernias in the EU in 2023 was 163.6 (per 100,000), which is lower than the global age-standardized rate of 204.69 reported in a previous GBD study [15].

Declines in hernia incidence may result from targeted prevention and modified risk factor exposure. Increased physical activity has been hypothesized to contribute to groin hernia development [16]. In a meta-analysis by Kuier et al., the amount of lifted load and duration of standing or walking per workday were associated with inguinal hernia development [17]. From a legal perspective, Directive 90/269/EEC establishes minimum health and safety standards for manual load handling in workplace regulations in the EU [18]. Central Europe experienced the steepest decline in ASR prevalence, and DALYs among the European regions. This finding is consistent with previous global studies, which also reported substantial declines in age-standardized rates in Central Europe [19]. This trend may partly reflect the higher baseline rates and case counts observed in 1990 in Central Europe compared with other regions. The accession of several Central European countries to the EU, particularly in 2004 (i.e., Poland, Czechia, Slovakia, Hungary, Slovenia), 2007 (i.e., Romania, Bulgaria), and 2013 (i.e., Croatia) [20] may have facilitated the adoption of EU guidelines and Council Directives in these countries.

Smoking has been proposed as an independent risk factor for recurrence of groin hernia [21]. Directive 2014/40/EU, implemented since 2014, has enforced anti-smoking policies, contributing to reduced smoking rates [22]. Regulations on smoking may also reduce the prevalence of chronic obstructive pulmonary disease, which has been suggested as a potential risk factor for groin hernia development [23]. Over the past three decades, the prevalence of

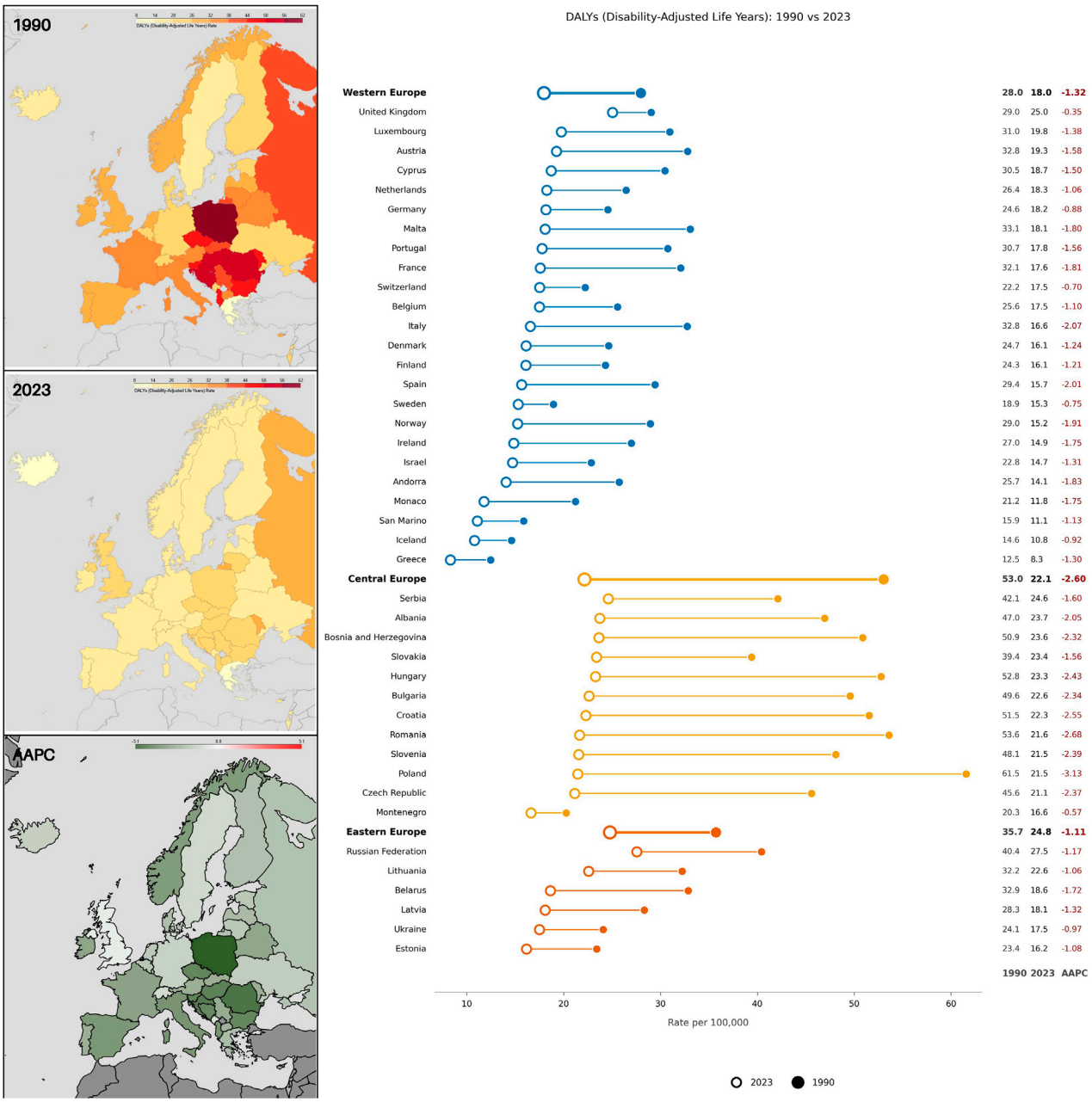


FIGURE 6
Geographical map of Europe representing ASR DALYs of hernias in 1990, 2023, and annual average percent change (AAPC) according to color intensity. Regions and countries are also represented in a dumbbell plot on the right panel along with corresponding rates, ranked in descending order according to the 2023 estimates.

overweight and obesity has risen in Europe for both genders [24]; Obesity has been suggested as a protective factor against inguinal hernia development [25, 26]. Consequently, increasing obesity rates may have led to a decreased incidence of hernias. Since prevalence is influenced by incidence, a decline in new cases also reduces the number of people living with hernias (i.e., prevalence) in the long term.

The observed decline in hernia prevalence across the EU and European regions, corroborated by population based studies from across Europe [4–6], may in part reflect improved access to surgical treatment resulting from economic development and progressive strengthening of healthcare systems. Broader socioeconomic changes, including transitions from middle-to high-income status, rising GDP *per capita*, and improvements in the Human Development Index and Sociodemographic Index, may also have contributed to the reduction in hernia prevalence over time. The advancement of surgical techniques, including the increasing use of minimally invasive approaches (i.e., laparoscopic and robotic surgery) [27], refinement of existing techniques, introduction of tension-free mesh repair

[28], and advances in mesh technology (e.g., large pore meshes) [29] may have also contributed to the reduction in ASR prevalence and DALYs. These advancements are exemplified by the experience in Sweden, where an increasing proportion of hernias are repaired using laparo-endoscopic techniques, alongside a reduction in reoperation rates for recurrence among both men and women [4]. Similarly, other longitudinal analyses have reported an increasing adoption of laparoscopic surgery in countries such as Romania and Italy [5, 6].

European Hernia Society (EHS) guidelines, along with evidence-based updates and improvements [10], have emphasized timely and accurate diagnosis and appropriate treatment, which may reduce emergency presentations, hernia-related complications, and mortality, thereby potentially contributing to reductions in ASR DALYs. Better availability of high-quality care and increased patient awareness may account for the persistently lower prevalence and disability observed in Western Europe relative to other European regions. Western Europe is designated as high-income in GBD database and has had lower ASR prevalence and DALYs compared to Eastern Europe from 1990 to 2023. Some of these discrepancies between European regions may be attributed to differences in the use of minimally invasive surgery for elective inguinal hernia repair. A recent report by Picciochi et al. demonstrated substantial geographic variation in its use, with rates of 70.6% in Western Europe, 37.9% in Northern Europe, 46.5% in Eastern Europe, and 15.4% in Southern Europe [29]. According to our results, the reduction in DALYs (at least in 2023) was mostly attributable to patients aged 50 years or older. Consistently, the mean age of patients undergoing groin hernia repair in population-based studies is usually older than 50 years [5, 31, 32]. However, the contribution of hernias in the pediatric population to the overall hernia burden should not be underestimated [33]. Moreover, undiagnosed or untreated hernias may persist into adulthood and subsequently contribute to disease prevalence and DALYs. Finally, we found that cause-specific mortality decreased during the study period. Similarly, an earlier study from Italy reported a significant reduction in mortality rates between 2015 and 2019, with a mean annual change of –4.6% [6]. Nevertheless, mortality following groin hernia repair remains very low, and previous studies suggest that mortality in groin hernia patients is not a major concern even among older patients undergoing elective surgery [34].

The well-documented multiple-fold higher prevalence and incidence rate of inguinal hernia in males [3] can be partially attributed to the anatomical weakness of the inguinal canal, which accommodates the spermatic cord in males, compared to the narrower female counterpart containing the round ligament [34]. Men's greater involvement in physical activities, heavy manual labor, weightlifting, or occupations requiring repetitive lifting increases abdominal pressure, predisposing them to hernia development [31]. Furthermore, the markedly higher smoking prevalence among males compared with females (28.5% vs. 5.96%, according to GBD data) is noteworthy [36, 37], given its association with an increased risk of recurrence. The pattern of age-specific prevalence rates and counts (for both males and females) observed in the EU in 2023 was similar to that reported for groin hernia repair prevalence in a nationwide Danish study [37]. Likewise, the pattern observed in incidence rates among men and women across age groups was consistent with findings from a population-based study of groin hernias, which reported the highest incidence rate among children aged 0 -1 year, followed by a decline through the 10 -14-year age group [39]. A smaller male-to- female prevalence ratio compared with the incidence ratio may suggest that disease duration is shorter in men, possibly reflecting earlier or more frequent surgical intervention in male patients. This observation aligns with previous reports indicating that hernias are underdiagnosed in women, that treatment is often delayed, and that surgical options are offered less frequently [40–42]. There is also a clear disparity between men and women in the use of minimally invasive surgery [5, 41]. Despite a markedly higher prevalence or incidence, the difference in ASR DALYs and ASR mortality between males and females is relatively less accentuated. Female sex has been associated with an increased risk of groin hernia recurrence [37]. Females are more prone to develop femoral hernias than males, which is associated with higher rates of complications like strangulation and emergency presentation [38, 43, 44]. A narrowing gender gap in ASR DALYs and ASR mortality may indicate an elevated risk of morbidity and cause-specific mortality among older females and points to potential gender disparities that remain unaddressed. Consistently, a study by Nilsson et al. demonstrated a substantially higher postoperative mortality risk in women than in men following groin hernia repair, particularly in the emergency setting [45]. Collectively, these findings suggest that sex-specific differences in presentation and outcomes warrant greater clinical attention and targeted management in female patients.

As previously mentioned, in addition to groin hernias, the GBD category "inguinal, femoral and abdominal hernia" also encompasses diaphragmatic, umbilical, and obturator hernias. Diaphragmatic hernias include acquired forms, such as hiatal and paraoesophageal hernias, which may develop in association with increased intra-abdominal pressure (e.g., due to obesity, pregnancy, or constipation), as well as age-related changes in tissue elasticity and muscle strength. Although endoscopic studies estimate the prevalence of hiatal hernia to be 50%–60% in individuals over 50 years of age (more frequent in women), only a minority (approximately 10%) become symptomatic [31]. Umbilical hernias occur in up to 10% of infants due to weakness of the musculature around the umbilical ring and often resolve spontaneously. In contrast, adult umbilical hernias are usually acquired and arise from conditions that increase intra-abdominal pressure, including multiple pregnancies, obesity, and liver disease with cirrhosis (i.e., ascites), which lead to stretching and thinning of linea alba [46]. Overall, umbilical hernias constitute up to 14% of abdominal wall hernias [1], thus, account for a relatively smaller share of (changes in) overall burden compared to groin hernias. On the other hand, the gender distribution of umbilical hernias has not yet been clearly established as studies report either predominance of males or females [47]. Obturator hernia accounts for 0.084% of all hernias, mainly affects older women, and is associated with significant morbidity. Combining the estimates of these hernia types (ventral hernias such as incisional, parastomal, epigastric and spigelian hernias were excluded; refer to code K43 in ICD-10) in GBD results constrains disease-specific interpretation and limit

applicability to clinical decision-making. As groin hernias account for the majority of abdominal wall hernias, overall estimates are disproportionately driven by this subtype, reducing precision for less common hernias.

Limitations

This analysis is subject to several important limitations inherent to GBD data in the context of hernia. First, GBD relies primarily on administrative and vital registration data, which vary in completeness and coding accuracy across countries. Evolution of reimbursement practices, including the implementation and development of Diagnosis-Related Group (DRG)-based reimbursement systems, may have influenced the observed results. Changes in ICD classifications and evolving diagnostic and management practices over time may introduce misclassification and temporal bias. Additionally, the increasing adoption of day-case inguinal hernia repair across Europe may have altered patterns of hospital admission and administrative reporting over time. Second, hernia cases that do not present for medical care, including asymptomatic or occult hernias are not captured, leading to likely underestimation of true prevalence. Third, GBD models do not incorporate granular clinical or health system factors, such as comorbidities, surgical urgency, intraoperative and postoperative data, access to care, or system capacity. Although common, complications of hernia repair such as chronic postoperative inguinal pain (CPIP) are not included in hernia burden estimates or as a separate category.

Despite these limitations, GBD remains a valuable tool for assessing broad population-level patterns, temporal trends, and geographic variation in hernia burden. The data are appropriate for macro-level epidemiologic comparisons and health policy planning, but findings should be interpreted cautiously and not extrapolated to detailed clinical or subtype-specific conclusions. Future work should integrate more granular clinical and healthcare data to address these limitations. In this regard, we plan to conduct a population-level analysis focused specifically on inguinal and femoral hernias in Belgium, in collaboration with the European Burden of Disease Network, using more detailed clinical and healthcare data. Such an approach may provide more precise estimates of hernia burden and allow evaluation of factors that cannot be captured using GBD data alone.

Conclusion

Although mortality and morbidity of abdominal wall hernias have significantly decreased in the EU in the last 33 years, the remaining burden is concentrated among elderly individuals and in specific locations. Moreover, there are clear sex-specific differences in presentation and outcomes of hernias. Future research should focus on addressing these inequities, optimizing resource allocation, and overcoming the inherent limitations of the GBD framework, potentially through the incorporation of existing population-based studies.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical approval was not required for the study involving humans in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and the institutional requirements.

Author contributions

AT and MK came up with the conceptualization for this investigation. MK and AT were responsible for data curation and formal analysis. AT, MK, and NC were tasked with generating the plots and tables (i.e., visualization). The original draft was written by AT, and was critically reviewed and edited by DM, NC, WZ, BD, BM, BA, GS, GT, LM, LB, TT, TH, VD, and MM; MM also administered and supervised the whole project. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontierspartnerships.org/articles/10.3389/jaws.2026.17645/full#supplementary-material

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