Original Article

Epidemiologic dynamics and the impact of COVID-19 on older-adult mortality: trends and disease burden

Dinâmica epidemiológica e impacto da COVID-19 na mortalidade de idosos: tendência e carga de doenças

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ABSTRACT

Objective: to analyze temporal trends and factors associated with mortality among older adults, considering population aging and the effects of the COVID-19 pandemic. **Methods:** ecological time-series study using data from the Brazilian Mortality Information System for individuals aged ≥ 60 years from 2014 to 2023. Sociodemographic variables, underlying causes of death, and place of death were examined. Trends were assessed through graphical analysis of annual series and calculation of age-standardized mortality rates. **Results:** mortality among older adults increased over the study period, with a predominance of deaths among men and higher frequency in those with low educational attainment. The impact of COVID-19 was pronounced — especially in older adults with comorbidities — raising hospital mortality rates. External causes, including falls and traffic injuries, remained relevant, particularly among men aged 60–69 years. **Conclusion:** mortality in older adults reflects the interaction of multiple social determinants of health, which were exacerbated by the pandemic and highlight persistent structural inequalities. **Contributions to practice:** the findings support the need for intersectoral public policies to expand access to primary care, promote healthy aging, and reduce inequalities, guiding prevention and care strategies for the most vulnerable groups.

Descriptors: Aging; Mortality; Aged; Chronic Disease; COVID-19.

RESUMO

Objetivo: analisar a tendência temporal e os fatores associados à mortalidade de idosos, considerando o contexto do envelhecimento populacional e os impactos da pandemia da COVID-19. **Métodos:** estudo ecológico de séries temporais com dados do Sistema de Informação sobre Mortalidade, abrangendo idosos com 60 anos ou mais, entre 2014 e 2023. Foram analisadas variáveis sociodemográficas, causas de óbito e local de ocorrência. As tendências foram avaliadas por meio de análise gráfica das séries anuais e cálculo de taxas padronizadas de mortalidade. **Resultados:** observou-se aumento da mortalidade em idosos ao longo do período, com predominância de óbitos no sexo masculino e maior frequência entre indivíduos com baixa escolaridade. O impacto da COVID-19 foi marcado, especialmente entre idosos com comorbidades, elevando as taxas de mortalidade hospitalar. Causas externas, como quedas e acidentes de trânsito, mantiveram-se relevantes, principalmente entre homens de 60 a 69 anos. **Conclusão:** a mortalidade de idosos reflete a interação de múltiplos determinantes sociais da saúde, exacerbados pela pandemia, evidenciando desigualdades estruturais persistentes. **Contribuições para a prática:** os achados reforçam a necessidade de políticas públicas intersetoriais que ampliem o acesso à atenção primária, promovam o envelhecimento saudável e reduzam desigualdades, orientando estratégias de prevenção e cuidado direcionadas a grupos mais vulneráveis.

Descritores: Envelhecimento; Mortalidade; Idoso; Doença Crônica; COVID-19.

Introduction

Population aging is a global, progressive, and accelerating phenomenon with direct implications for health systems, the economy, and social organization[1]. Recent estimates indicate that by 2030, the world's population aged 60 years or older will have increased substantially compared with 2019, potentially exceeding 2.1 billion by 2050. Approximately 80% of these individuals are expected to live in low- and middle-income countries, where health infrastructure and system responsiveness remain limited — posing significant challenges to healthy and high--quality aging[2]. This scenario becomes even more complex when considering the unequal distribution of disease burden, which is strongly influenced by social determinants of health, including environmental, economic, and cultural factors that disproportionately affect populations with lower socioeconomic status, limited education, racial minorities, and residents of areas with inadequate infrastructure[3].

In Brazil, population aging is occurring rapidly, characterizing a complex demographic and epidemiological transition. Older adults currently represent 13.8% of the national population, and in the state of Minas Gerais this proportion reaches 15.4%, equivalent to more than three million people[4]. Beyond increasing life expectancy, the country faces a growing number of years lived with disability, particularly due to chronic noncommunicable diseases, as shown in national burden of disease analyses[5].

This context places growing demands on Brazil's Unified Health System (SUS), as the older population exhibits a higher prevalence of chronic noncommunicable conditions such as hypertension, diabetes mellitus, cardiovascular diseases, and neoplasms, along with greater vulnerability to functional decline, recurrent hospitalizations, and premature mortality[6-7].

In response, Brazil has implemented structuring policies such as the National Health Policy for Older Adults (2006) and the National Primary Care Policy, which designates the Family Health Strategy as the core model of primary care organization[6,8]. These initiatives acknowledge population aging as a priority, establishing guidelines for chronic disease prevention, promotion of functional autonomy, and comprehensive access to care. Nevertheless, major gaps persist, including insufficient coverage in certain regions, weak coordination across care levels, limited integration of palliative and home care, and regional inequalities in financing and infrastructure[9-10]. Such limitations hinder the SUS's ability to fully meet older adults' needs, particularly in crises like the COVID-19 pandemic, during which hospital overload and shortages of intensive care unit (ICU) beds underscored the need to strengthen an integrated and responsive care network[11-12].

Evidence shows that mortality among older adults remains high. According to the Mortality Information System, 60% of deaths in Brazil occur among individuals aged ≥ 65 years, predominantly among women (68.5%) and most frequently in the 65–74-year age group[13]. In 2018, 65% of older-adult deaths were attributed to circulatory system diseases, followed by neoplasms and respiratory diseases. Cardiovascular conditions — particularly ischemic heart disease and cerebrovascular disease — accounted for more than 30% of deaths, often linked to risk factors such as hypertension and diabetes, which become more prevalent with age[7].

The COVID-19 pandemic profoundly disrupted this landscape, amplifying social and racial inequalities and imposing unprecedented strain on health systems[11,14]. In Brazil, as of June 3, 2020, there had been 35,126 deaths among older adults, representing 71% of all fatalities[15]. In Minas Gerais, lethality rates ranked among the highest in the country during the critical pandemic period[11], reflecting both structural vulnerabilities and the synergistic interaction between COVID-19 and preexisting chronic conditions. Elevated mortality was also associated with barriers to specialized care, hospital overload, and delays in ICU bed availability, particularly at the 2021 peak[14]. International evidence indicates that in urban settings, vulnerability to the pandemic was heterogeneous and

influenced not only by clinical factors but also by the ability to maintain physical distancing, access to healthcare, and urban design features[16].

Beyond the acute impact of COVID-19, hospitalizations among older adults — regardless of cause — are strongly associated with higher risks of clinical complications, accelerated functional decline, and increased mortality, also generating significant economic repercussions for the SUS and families[7]. The pattern of place of death in Brazil, predominantly hospital-based, was already evident before the pandemic, with regional variations and implications for end-of--life quality[9].

Understanding mortality patterns and trends in this population is essential to inform evidence--based public policies, guide preventive strategies, and optimize resource allocation. In Minas Gerais, however, gaps persist in longitudinal analyses that integrate temporal trends, epidemiologic profiles, and the effects of critical events such as the COVID-19 pandemic on older-adult mortality. Therefore, this study aimed to analyze temporal trends and factors associated with mortality among older adults, considering population aging and the effects of the COVID-19 pandemic.

Methods

Study design

We conducted an ecological time-series study with an observational, retrospective, descriptive, and analytical approach, using secondary data from public, official databases of the Department of Informatics of the Unified Health System (DATASUS). We drew on the Mortality Information System and population estimates from the Brazilian Institute of Geography and Statistics (IBGE)[17-18].

Study population and period

All death records for individuals aged ≥ 60 years residing in the state of Minas Gerais, Brazil, oc-

curring between January 1, 2014, and December 31, 2023, were included[17]. Data extraction and analyses were performed between May and June 2025.

Classification of causes of death

Underlying causes of death were classified according to the International Classification of Diseases[19], considering chapters and categories of greatest epidemiologic relevance for older adults.

Variables

The following variables were analyzed: sex; age group (60–69, 70–79, ≥ 80 years); race/skin color; marital status; schooling; place of death; municipality of occurrence (same as or different from the city of residence); and time of day of death (morning, afternoon, evening, night).

Mortality rate estimation

We calculated annual mortality rates per 100,000 older inhabitants using IBGE population estimates as the denominator. Rates were age-standardized by the direct method, adopting as the standard population the age structure of the older-adult population of Minas Gerais in the initial year of the series (2014).

Data extraction and processing

Data were extracted with the TabWin application (DATASUS) and exported to spreadsheets for cleaning and consistency checks. Only records containing essential information for the analysis were retained.

Data analysis

Descriptive analysis included absolute and relative frequencies for categorical variables and measures of central tendency and dispersion for continuous variables. Temporal assessment relied on graphical

inspection of annual series and visual comparison of the pre-pandemic period (2014–2019) with the pandemic/post-pandemic period (2020–2023), highlighting seasonal variation and shifts in the profile of causes of death.

Results

Between 2014 and 2023, a total of 1,033,919 deaths were recorded among individuals aged ≥60 years in Minas Gerais. The absolute number of deaths rose from 84,016 in 2014 to 99,940 in 2019, followed by a sharp increase in 2020 (109,302) and a peak in 2021 (134,628), coinciding with the period of greatest impact of the COVID-19 pandemic. In the subsequent years, the count declined to 119,986 in 2022 and 116,027 in 2023.

Age-standardized mortality rates ranged from 3,103 per 100,000 older adults in 2014 to 3,081 per 100,000 in 2023, reaching a maximum of 3,815 per 100,000 in 2021. By age group, deaths were concentrated among those aged ≥ 80 years (45.0%), followed by 70–79 years (30.0%) and 60–69 years (25.0%). The most pronounced proportional increase occurred in the ≥ 80-year group, reflecting population aging and greater survival to advanced ages (Figure 1).
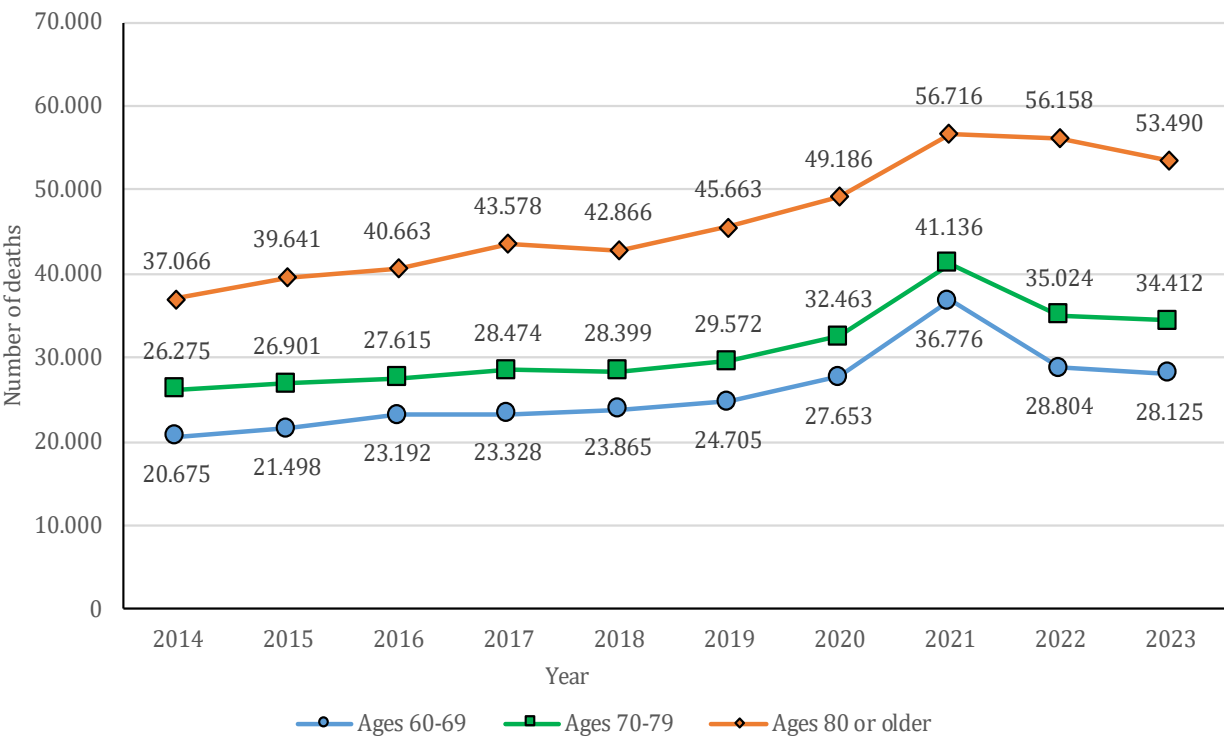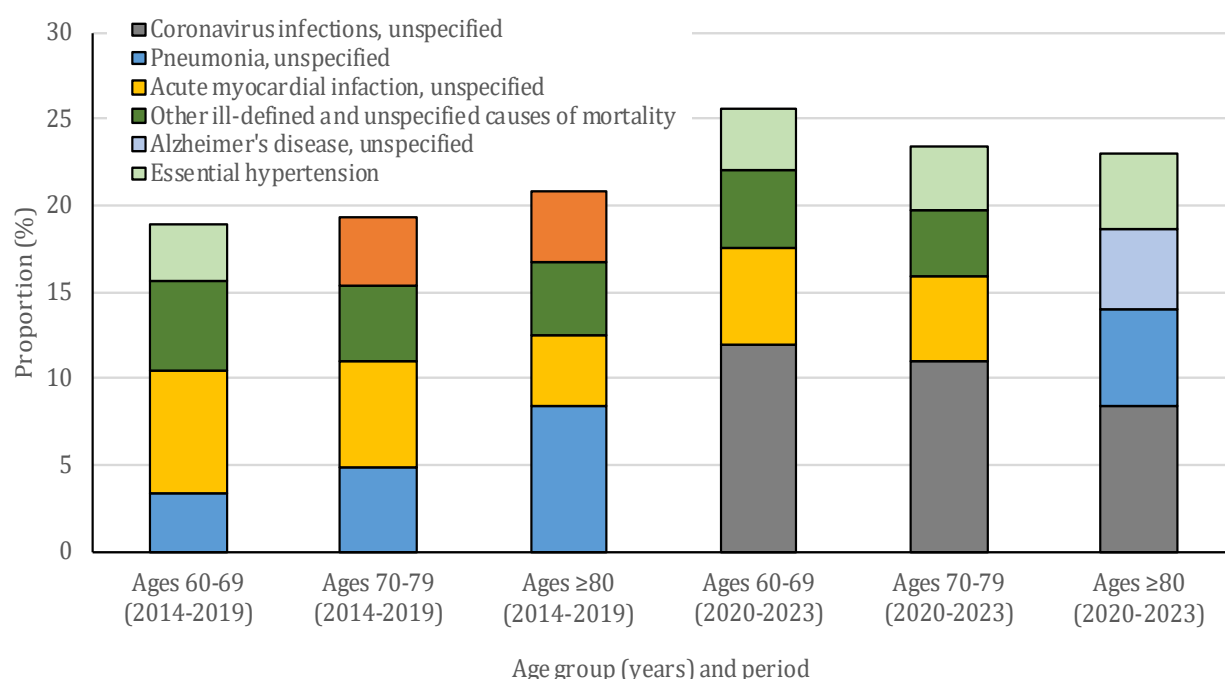

Figure 1 – Number of deaths among older adults by age group, 2014–2023. Uberaba, Minas Gerais, Brazil, 2025

Analysis of the leading causes of death showed a substantial shift in ranking between the pre-pandemic period (2014–2019) and the pandemic/post-pandemic period (2020–2023). COVID-19 became the top cause across all age groups in the latter period, accounting for 11.9% of deaths at ages 60–69, 10.9% at 70–79, and 8.4% at ≥ 80. The relatively greater proportional impact among those aged 60–79 years may be related to higher social mobility and lower isolation early in the pandemic (Figure 2).

Figure 2 – Leading causes of death among older adults by age group, 2014–2023. Uberaba, Minas Gerais, Brazil, 2025

Acute myocardial infarction (AMI), previously the leading cause among those aged 60–79 years, moved to second place while remaining a major contributor to geriatric mortality. Pneumonia and other respiratory diseases declined in relative share in the younger old but remained prominent among those aged ≥ 80 years, indicating persistent respiratory vulnerability. Among individuals aged ≥ 80 years, Alzheimer's disease maintained a leading position, underscoring the burden of chronic degenerative conditions irrespective of the pandemic context. The increase or persistence of "other ill-defined causes" likely reflects diagnostic challenges, restricted access to diagnostic tests, and service overload during the pandemic period.

Sociodemographic characteristics showed a roughly balanced sex distribution (male: 50.8%). Most deaths occurred among White individuals (53.0%), followed by Brown (33.0%) and Black populations (9.7%). Regarding marital status, married (35.5%) and widowed (33.7%) individuals predominated. With respect to schooling, 43.0% had primary education, whereas only 4.2% had completed higher education (Table 1).

Table 1 – Sociodemographic characteristics of deaths among older adults (≥60 years) (n = 1,033,919), 2014–2023. Uberaba, Minas Gerais, Brazil, 2025

Variables	n (%)*
Sex	
Female	508,244 (49.2)
Male	525,385 (50.8)
Race/skin color	
White	547,909 (53.0)
Black	100,400 (9.7)
Yellow	3,709 (0.4)
Brown	340,962 (33.0)
Indigenous	926 (0.1)
Not reported	40,013 (3.9)
Marital status	
Single	143,293 (13.9)
Married	367,034 (35.5)
Widowed	348,548 (33.7)
Separated/Divorced	64,478 (6.2)
Cohabiting (common-law union)	15,523 (1.5)
Unknown	57,190[†] (5.5)
Not reported	37,853 (3.7)
Schooling	
No schooling	7,492 (0.7)
Primary education, grades 1 – 4	192,436 (18.6)
Lower secondary, grades 5 – 8	252,500 (24.4)
Upper secondary	201,553 (19.5)
Incomplete higher education	104,335 (10.1)
Complete higher education	43,718 (4.2)
Unknown	159,217[†] (15.4)
Not reported	72,668 (7.0)

Source: Mortality Information System (SIM/DATASUS), 2014–2023
*Percentages calculated based on the total number of deaths among older adults; [†] Unknown = explicit "unknown" recorded by the informant

Seasonality analyses showed higher mean daily deaths in July (6 years) and August (2 years) during 2014–2020 and again in 2023. At the pandemic peak, March 2021 recorded the highest daily mean (491.0 deaths/day), while January 2022 marked that year's peak (427.9 deaths/day).

By time of day, 28.0% of deaths occurred in the morning, 25.3% in the afternoon, 24.8% in the evening, and 21.9% at night, indicating a slight morning predominance. Regarding place of death, 69.0% occurred in hospitals, 8.0% in other healthcare facilities, and 20.5% at home. In 75.0% of cases, death occurred in the same municipality as the decedent's residence.

Discussion

Our findings indicate that older-adult mortality in Minas Gerais from 2014 to 2023 resulted from the intersection of structural, epidemiologic, and contextual forces. Population aging alone does not account for the observed patterns. Overlapping health crises — most notably the COVID-19 pandemic — combined with persistent social and racial inequalities created a high-risk environment with uneven distribution across groups. These inequalities reflect complex social determinants, ranging from unequal access to health services to housing and working conditions, whose effects were amplified during the pandemic[3,16]. This picture aligns with global analyses showing that structural inequities modulate the impact of demographic and epidemiologic transition, yielding settings in which longer life expectancy coexists with persistent gaps in healthy longevity[12,20]. In Brazil, such disparities were even more marked among older adults living in less developed regions, underscoring that social vulnerability remains a key determinant of geriatric mortality[12,21].

The results highlight not only the direct impact of COVID-19 on mortality in older adults but also the enduring roles of chronic diseases, sociodemographic inequalities, and seasonal factors in shaping the state's mortality profile. The predominance of deaths among men and the high proportion of individuals with low schooling reinforce the salience of social determinants of health and point to gaps in timely access to preventive measures, early diagnosis, and effective therapies[22].

With respect to race/skin color, the distribution of deaths was broadly proportional to the demographic composition of the older population in Minas Gerais, and we did not observe excess mortality among historically vulnerable groups during the study period. Even so, evidence from other settings shows that the interplay between racial and socioeconomic inequalities intensifies mortality disparities, producing cumulative disadvantages reflected in lower life expectancy and greater exposure to preventable diseases[8,23]. In the Brazilian context, these disparities were also documented among Black and Brown older adults, who faced higher risks of death from COVID-19 and reduced access to therapeutic resources, reaffirming the weight of racial inequalities as determinants of mortality risk[24].

Additionally, Brazilian burden-of-disease data indicate that, despite gains in life expectancy, older adults experience high levels of morbidity, underscoring the need for strategies that combine primary and secondary prevention[5]. This finding aligns with international evidence documenting a widening gap between life expectancy and healthy life expectancy, showing that longevity gains have not been matched, to the same extent, by improvements in functional health[20,25].

The rise in hospital mortality may reflect both increased medicalization at the end of life and the reorganization of care pathways during the pandemic, which redirected resources toward critically ill patients[12]. The longstanding predominance of hospital deaths reinforces the need for the Brazilian care network to incorporate palliative care models and non-hospital alternatives to ensure quality at the end of life[9]. This pattern has been accompanied by greater in-hospital management of severe acute and chronic conditions, including sepsis, whose lethality remains high in Brazil and has shown an upward trend in recent years[26]. Evidence suggests that the absence of

integrated, longitudinal care networks and home-based services heightens dependence on hospitals as the near-exclusive setting for dying, contributing to end-of-life experiences that are misaligned with patient and family preferences[10,27].

The predominance of deaths in hospitals and other health facilities indicates that most older adults accessed health services at the end of life — reflecting both the centrality of hospitals within Brazil's care model and the high demand for complex care[9,12]. However, such access does not necessarily translate into resolution or quality, as hospital overload, limited ICU capacity, and shortages of multidisciplinary teams during the pandemic created substantial barriers[11-12]. The persistence of hospital-based deaths highlights the need to expand home care and palliative care strategies to provide alternatives to hospitalization and better align end-of-life trajectories with patient preferences[9-10,27].

COVID-19 disproportionately affected older adults, amplifying biological vulnerabilities such as immunosenescence and epidemiologic vulnerabilities linked to the high prevalence of comorbidities in this age group. Case-fatality rates far exceeded those observed in younger groups[28]. In Minas Gerais, the cumulative effect of high case incidence, hospital overload, and delays in targeted protective measures may have intensified these disparities. This pattern is consistent with global analyses emphasizing the role of social vulnerability, urban design, and occupational exposure in shaping the risk of COVID-19 mortality[16]. Losses in life expectancy during the pandemic were more pronounced among low-income older adults and racial/ethnic minorities, reflecting a disproportionate impact that reproduced longstanding inequalities[10,23,29].

Beyond infectious diseases, external causes remain a significant component of mortality among older adults. We observed an upward trend in these causes — particularly among younger males within the older-age spectrum — with notable contributions from traffic injuries, falls, and interpersonal violence[30]. This pattern aligns with international estimates indicating that, although external causes account for a smaller share than chronic diseases, they play a meaningful role in older-adult mortality in middle-income countries, especially when linked to environmental factors and rapid urbanization[20].

Understanding mortality in older adults requires an integrated approach that considers income, education, race/skin color, and territorial context as modifiers of risk and access to care. Public policies should strengthen primary care, promote early disease detection, and reduce structural barriers by coordinating health actions with broader social policies. Evidence suggests that robust primary care reduces inequalities, improves responses to health emergencies, and enhances equity in long-term survival[10,29]. It is also necessary to implement strategies that foster urban and community resilience — integrating sustainability and vulnerability-reduction measures — to mitigate the impacts of future public health emergencies[16]. Consistent use of epidemiologic surveillance systems and time-series analyses is essential to guide evidence-based strategies in settings undergoing rapid epidemiologic transitions.

Study limitations

This study used secondary data from the Mortality Information System, which are subject to underreporting, notification delays, and misclassification — particularly for ill-defined causes or deaths involving multiple contributing conditions. The lack of individual-level information on functional status, specific comorbidities, socioenvironmental determinants, and actual use of health services constrained analytic depth. The ecological design does not permit causal inferences at the individual level. Future research should integrate multilevel approaches, combine population-based and clinical data, include more granular socioeconomic variables, and apply geospatial analyses to identify higher-risk areas. Comparative analyses across states and longitudinal cohorts may deepen understanding of health trajectories and the impacts of public policies on older-adult mortality.

Contributions to practice

Priority strategies include strengthening primary care; improving clinical management of acute and chronic conditions; expanding epidemiologic surveillance; and implementing targeted prevention for external causes. Integration between health and social policies, coupled with consistent epidemiologic analyses, can guide interventions for the most vulnerable older populations and promote healthy, safe aging. These findings expand the evidence base at the public health–nursing interface, showing how population time-series can inform clinical protocols, surveillance, and intersectoral policies. By translating secondary data into practice-oriented indicators, they support decision-making across levels of care, reinforce nursing's strategic role, and help reduce inequities — while providing a reference for future studies and for performance assessment of health systems in contexts of crisis and demographic transition.

Conclusion

Mortality among older adults showed an upward trend, with a sharp increase in 2020 and a peak in 2021 due to the COVID-19 pandemic. Deaths were more frequent among men and those with low schooling, with chronic diseases and external causes remaining prominent. With respect to race/skin color, mortality proportions generally mirrored the composition of the older population, with no excess observed in specific groups. Overall, mortality patterns in the period reflected population aging, structural inequalities, and the impact of the pandemic.

Authors' contributions

Conception and design, data analysis and interpretation, and manuscript drafting: Rodrigues PSM, Zullo AS. Data interpretation: Virtuoso Junior JS. Manuscript drafting: Silva MPC, Meneguci J. Final approval of the version to be published and responsibility for all aspects of the text, ensuring the accuracy and integrity of any part of the manuscript: Rodrigues PSM, Zullo SA, Silva MPC, Meneguci J, Virtuoso Junior JS.

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