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Original Research

20-Year trends of hospitalisation among people with dementia: a region-wide retrospective cohort study from Lombardy, Italy

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ABSTRACT

Objectives: The aim of this study was to investigate the trends of hospitalisations among people with dementia, linking region-wide hospital and demographic health records.
Study design: A retrospective cohort study was conducted using hospitalisation health records from the Lombardy region in Italy.
Methods: The study included people aged ≥65 years with a diagnosis of dementia who were hospitalised between 2002 and 2020 in Lombardy, which is the most populated region in Italy with 10 million inhabitants. Using data on resident population, this study computed rates of hospitalisation by calendar year, age, sex and cause of hospitalisation.
Results: In total, 340,144 hospitalised patients with dementia were included in the study. The rate of hospitalisation was 100.6 per 10,000 in 2002 and progressively decreased to 65.1 per 10,000 in 2020. The average age at hospitalisation in 2002 was 78.9 years for men and 81.8 years for women, which increased to 82.0 years and 84.2 years, respectively, in 2020. Respiratory diseases caused 10.4% of all hospitalisations in 2002 and grew steadily to 26.8% in 2020, becoming the leading cause of hospital admissions since 2017.
Conclusions: Hospitalisation patterns for people with dementia have changed over the last 20 years, reflecting evolving epidemiological trends and the impact of healthcare policies. Region-wide administrative health record data analysis should be further utilised to explore the health needs of people with dementia and inform the planning, implementation and monitoring of effective prevention strategies in this population group.

Introduction

Dementia is the most prevalent neurological disorder and the seventh leading cause of death worldwide.[1,2] The incidence of dementia increases with age, and global estimates of prevalence in individuals aged ≥65 years are 8.1% for women and 5.4% for men.[3] Regional prevalence estimates range from 4% in the South-East Asia region to 8.5% in the European region.[3] The risk of dementia and its distribution by gender are impacted by longevity, biological and social determinants, including hormonal patterns, epigenetics, frailty, and occupational and educational opportunities.[4] Research should include individuals from diverse backgrounds and locations.[5] National-level data on dementia burden by age and sex are lacking or out of date for most countries worldwide. International research collaborations attempted to estimate the prevalence and incidence of dementia in Europe over recent decades (Eurodem, EuroCoDe and ALCOVE);[6] however, there is conflicting evidence on current burden estimates at country and regional levels. Some record-based and cohort studies in high-income countries have reported increasing trends in dementia, while other studies have reported decreasing or stable trends, depending on the data sources and study populations.[7] Moreover, during the last 30 years, diagnostic criteria for some dementia conditions, such as for Alzheimer's disease, have changed considerably.[8] The most up-to-date and comprehensive systematic review and meta-analysis estimated an age- and sex-standardised prevalence

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rate of dementia of 7.1% in people aged ≥65 years, pooling data from nine European studies carried out over the period 1993 to 2018.[9]

In addition to its clinical and epidemiological relevance, dementia has major impacts on families, communities and economies, and is recognised as a key area of research and political priority by health agencies and governments that are planning, implementing and monitoring targeted dementia policies and programmes.[10] Indeed, in high-income countries, the cost per person with dementia has a huge economic effect on families and governments.[11] In 2019, the World Health Organisation (WHO) estimated that the cost per person for medical, social and informal care was US$31,144 for each of the 14.1 million people with dementia in Europe.[3] Hospital is the most expensive setting of care, and people with dementia have a 42% higher risk of hospitalisation than individuals without dementia.[12] Investments in the prevention of dementia and of its acute and chronic consequences are important for the future economic sustainability of our societies;[13] thus, it is crucial to explore patterns of hospitalisation and acute care for people with dementia.

Previous studies have investigated hospital use for people with dementia,[14] although only partially and with many limitations. These studies included reports on regional cohorts or surveys, which were unable to provide precise estimates on the distribution of dementia comorbidities, or to determine how, when and why people with dementia access healthcare.[14] To overcome these limitations, the current study aimed to describe the trends of hospitalisations over the last 20 years among people with dementia aged ≥65 years in Lombardy, Italy, and to determine the principal causes of hospital admission using routinely collected data from the Lombardy region archive of hospitalisations for 10 million individuals. Ultimately, this study aimed to identify and quantitatively evaluate clinical and sociodemographic risk factors for hospitalisations in people with dementia in order to inform clinicians, programme officers and policymakers.

Methods

A retrospective cohort study was conducted using hospitalisation health records from the Lombardy region in the north of Italy. Lombardy has a population of 10 million (16% of the total Italian population). The database covers all hospital admissions that occurred in Lombardy. It includes administrative and clinical data of admissions, including year of admission and discharge, primary diagnosis and up to five co-existing secondary conditions and procedures coded according to the International Classification of Diseases, Clinical Modification 9th revision (ICD-9 CM). Access to data was operated through the Lombardy regional data warehouse platform, and data were anonymous.

The study population included discharges from hospital for individuals aged ≥65 years with a primary or secondary diagnosis of dementia from 1 January 2002 to 31 December 2020. Data collected in 2020 were included in order to observe the impact of the COVID-19 pandemic on the study population; however, the current study did not include *a priori* data collected in 2021 because of the many national and regional policies introduced during the COVID-19 pandemic that influenced the accessibility to many care settings, including hospitals.

Dementia was defined according to the Italian national guidelines on the use of information systems to code dementia, with inclusion and exclusion criteria (see Supplementary Table S1).[15] Table S1 provides the ICD-9-CM codes list associated with all dementia-related conditions. ICD-9-CM codes are used to identify dementia rates at the national level; regional data is entered each year into the national Italian information databases. Thus, in the current study, an individual was identified as having dementia if one of these dementia-related codes (as a primary or co-existing diagnosis) was present in their hospital records.

The following variables were considered in the current analysis: year of discharge, sex, age at hospitalisation, leading cause of hospitalisation as primary diagnosis at the time of discharge and secondary diagnosis. The causes of hospitalisation were classified as primary diagnoses and labelled according to the ICD-9-CM chapter (1–17) to which the codes belong and to the clinical area represented.

Using data on the resident population aged ≥65 years in the Lombardy region from 2002 to 2020, retrieved from the online Italian National Institute of Statistics (ISTAT) database, this study computed rates of hospitalisation for each calendar year, sex and six five-year age groups (i.e., 65–69, 70–74, 75–79, 80–84, 85–89 and ≥90 years). To avoid the influence of demographic transition, only people aged ≥65 years in both the numerator and denominator of the hospitalisation rate were included. Furthermore, to describe the causes of hospitalisation, the proportions of hospitalisations divided by the six leading causes were calculated, considering all hospitalised people with dementia as the denominator, for each calendar year, sex and age group.

Results

A total of 340,144 hospital discharges were registered in Lombardy from 1 January 2002 to 31 December 2020 for people aged ≥65 years with a primary or secondary diagnosis of dementia, from a total of 335,904 hospitalisations during the study period, of which 211,709 (63.0%) were women and 124,195 (37.0%) were men.

Table 1 reports dementia hospitalisation rates (per 10,000) by sex and age, in 2002–2004, 2005–2009, 2010–2014, 2015–2019 and 2020, and percentage differences between the most recent periods. Fig. 1 shows annual hospitalisation trends over the whole study period for the total, male and female populations, by age group. The rate of hospitalisation decreased over the study period, ranging from 100.6 per 10,000 in 2002 to 65.1 per 10,000 in 2020. The hospitalisation rate declined by about 9% in 2015-2019 compared to 2010-2014, while a 17.7% decrease in hospitalisations was observed when comparing 2015–2019 to 2020. In men, the rate in 2002 was about 88 per 10,000 and decreased over time to reach a rate of 61.4 per 10,000 in 2020. A similar pattern occurred among women, although with higher rates (from 108.9 to 67.9/10,000). Compared with all ages, age group patterns showed a reverse trend; hospitalisation rates in men were higher than in women per age group, and the difference increased among older age groups. Overall, dementia hospitalisation rates increased with increasing age. Hospitalisation for individuals aged ≥90 years was approximately 15 times higher than in the youngest age group in 2002 (320.7/10,000 vs 21.7/10,000, respectively), and it was over 20 times higher in 2020 (220.3/10,000 vs 10.3/10,000, respectively).

Fig. 2 shows the average age at hospitalisation by sex over the study period. The average age at hospitalisation in men was 78.9 years in 2002 and increased to 82.0 years in 2020, while in women, it was 81.8 years in 2002 and increased to 84.2 years in 2020.

Table 2 reports the six leading causes of hospitalisation among people with dementia in four selected periods, plus 2020, with percentage differences between the most recent periods. In 2020, the six leading causes of hospitalisation in people with dementia aged ≥65 years were respiratory disease (RSP), cardiovascular disease (CVD), trauma (TRM), gastrointestinal disease (GI), genitourinary disease (GU) and oncological disease (ONC). Fig. 3 shows the annual hospitalisation percentages by the three leading causes (i.e., CVD, RSP and TRM), overall, in men and in women, separately. The leading causes of hospitalisation showed some differences in trends over the last two decades. Overall, from 2002 to 2016, CVD

Table 1
Average annual number of hospitalisations and corresponding rates (per 10,000) among patients aged ≥65 years with dementia, overall and by sex and age group, in 2002–2004, 2005–2009, 2010–2014, 2015–2019 and 2020, and the percentage differences between the rates for the most recent periods. Lombardy, Italy.

Characteristic	2002–2004		2005–2009		2010–2014		2015–2019		2020		2015-19 vs 2010–14 (% difference)	2020 vs 2015–19 (% difference)
	Annual average (n)	Rate per 10,000	Annual average (n)	Rate per 10,000	Annual average (n)	Rate per 10,000	Annual average (n)	Rate per 10,000	Annual average (n)	Rate per 10,000		
Total	17,031	100.6	18,738	99.9	17,690	86.9	17,546	79.07	14,941	65.08	−8.99	−17.70
Sex												
Men	5899	88.0	6535	85.5	6624	77.8	6922	72.91	6092	61.39	−6.30	−15.80
Women	11,132	108.9	12,203	109.8	11,066	93.4	10,624	83.68	8849	67.89	−10.40	−18.87
Age group (years)												
65–69	1113	21.7	1041	18.6	781	14.6	717	12.3	577	10.3	−16.08	−16.37
70–74	2231	50.3	2092	44.6	1737	33.4	1407	28.1	1235	22.6	−15.90	−19.52
75–79	3883	112.1	3873	102.1	3250	78.3	2984	63.7	2165	48.1	−18.67	−24.45
80–84	4366	208.4	5266	195.9	4771	156.2	4570	133.6	3986	105.0	−14.51	−21.39
85–89	3305	290.1	3918	312.7	4611	255.6	4723	223.3	4155	180.8	−12.64	−19.04
≥90	2133	320.7	2549	346.1	2540	313.2	3146	280.4	2823	220.3	−10.46	−21.46
Men (age group in years)												
65–69	589	24.8	542	20.6	420	16.6	382	13.7	309	11.5	−17.15	−16.06
70–74	1047	55.0	980	47.0	858	36.0	717	30.9	628	24.6	−14.26	−20.28
75–79	1553	118.2	1588	104.6	1463	83.1	1394	67.4	1059	53.0	−18.9	−21.42
80–84	1405	206.8	1780	194.9	1829	162.2	1900	139.5	1701	108.2	−13.99	−22.43
85–89	855	286.3	1098	316.7	1450	269.6	1661	237.7	1563	194.4	−11.82	−18.21
≥90	449	340.3	548	376.1	603	351.5	868	330.1	832	261.8	−6.1	−20.69
Women (age group in years)												
65–69	523	19.0	498	16.8	361	12.9	334	10.9	268	9.1	−14.94	−16.72
70–74	1184	46.8	1112	42.7	880	31.2	691	25.7	607	20.9	−17.67	−18.82
75–79	2330	108.4	2285	100.4	1787	74.8	1590	60.8	1106	44.3	−18.75	−27.19
80–84	2960	209.2	3487	196.4	2941	152.7	2669	129.6	2285	102.7	−15.13	−20.76
85–89	2450	291.5	2820	311.1	3161	249.7	3062	216.2	2592	173.5	−13.42	−19.77
≥90	1684	315.9	2001	338.7	1937	302.9	2278	265.2	1991	206.6	−12.44	−22.11

was the leading cause of hospitalisation, with percentages around 17–19%, which declined to 15.7% in 2020. The percentages of hospitalisations as a result of RSP increased from 10.4% in 2002–2004 to almost 27% in 2020 (including a 58% increase from 2015–2019 to 2020), to become the most frequent diagnosis of all hospitalisations since 2017. Among women, CVD remained the leading cause until the emergence of COVID-19, when RSP showed a peak in 2020 in both sexes. Steady trends were observed for TRM, with percentages ranging between 8% and 10% of overall hospitalisations over the study period. TRM percentages were two times more frequent among women than men. The other main causes of hospitalisations remained stable over the last two decades: GU around 3–7%, GI at 3–5% and ONC at 2–3%.

Finally, Table 3 describes the top three illnesses/conditions per main cause of hospitalisations among people with dementia over the study period. During the last 20 years, the main illnesses and conditions (per disease chapter) that led people with dementia to receive acute care were as follows: for RSP, pneumonia and acute respiratory failure; for CVD, left heart failure, acute cerebrovascular insufficiency and cerebral thrombosis; for TRM, fracture of femur; for GI, intestinal obstruction, cirrhosis of liver and acute pancreatitis; for GU, urinary tract infection, acute kidney failure and chronic kidney disease; and for ONC, bladder cancer, lung and bronchus cancer and liver cancer.

Discussion

The study results enable the characterisation of epidemiological trends over a long time period, quantifying access to acute care by the leading causes of hospitalisation for people with dementia. Overall, a general decrease in hospitalisation rate from 100.6 to 65.1 (per 10,000) was observed across the study period for both men and women. Men had higher hospitalisation rates than women at each age group, and these differences increased with increasing age. The greatest difference was seen among people aged ≥90 years, with a hospitalisation rate of 261.8 per 10,000 for men and 206.6 per 10,000 for women. In addition, this study found that RSPs were the most frequent cause of hospitalisations for people with dementia. At the end of the study period, almost one in three older people with dementia were admitted to hospitals due to RSPs, highlighting a tremendous peak during the COVID-19 pandemic.

The current study data showed that men with dementia had a much more need for acute care than women with dementia over the last two decades. The study findings are consistent with the existing literature,[16] where increasing age has been reported to be a crucial risk factor for the hospitalisation of patients with dementia. In contrast with the current data, increasing trends in hospitalisation rate were found in other similar studies.[16,17] As suggested by a previous review (which did not include study populations from Italy),[16] discrepancies may be attributable to different provisions of acute care between countries. Indeed, Italy has implemented several health policies to strengthen the dementia health services network, including, during the early 2000s, the introduction of 'memory clinics' (approximately 500 outpatient clinics intended for people with dementia), which aimed at coordinating the complex care of people with dementia and concentrating expertise and diagnostic techniques to specific centres. In 2014, the Italian Dementia National Plan was issued,[18] aimed at promoting health and social care for people with dementia, designing targeted clinical programmes and preventive interventions. Moreover, the decreasing trends in hospitalisations seen in the current study could be explained by the implementation of Italian health policies focussing on access-to-hospital criteria, which have changed over recent years.[19] These policies aimed to find more appropriate care settings and moved many services from inpatient to outpatient settings. Indeed, the trend of hospitalisations in the Italian general population has decreased steadily over the period 2002–2020 by approximately one-half.[20] These factors have led to changes in Italian healthcare delivery over the last two decades.

The study results suggest an influential role of the aforementioned policies tailored on dementia and on appropriateness for provision of acute care. Therefore, the study findings may indicate

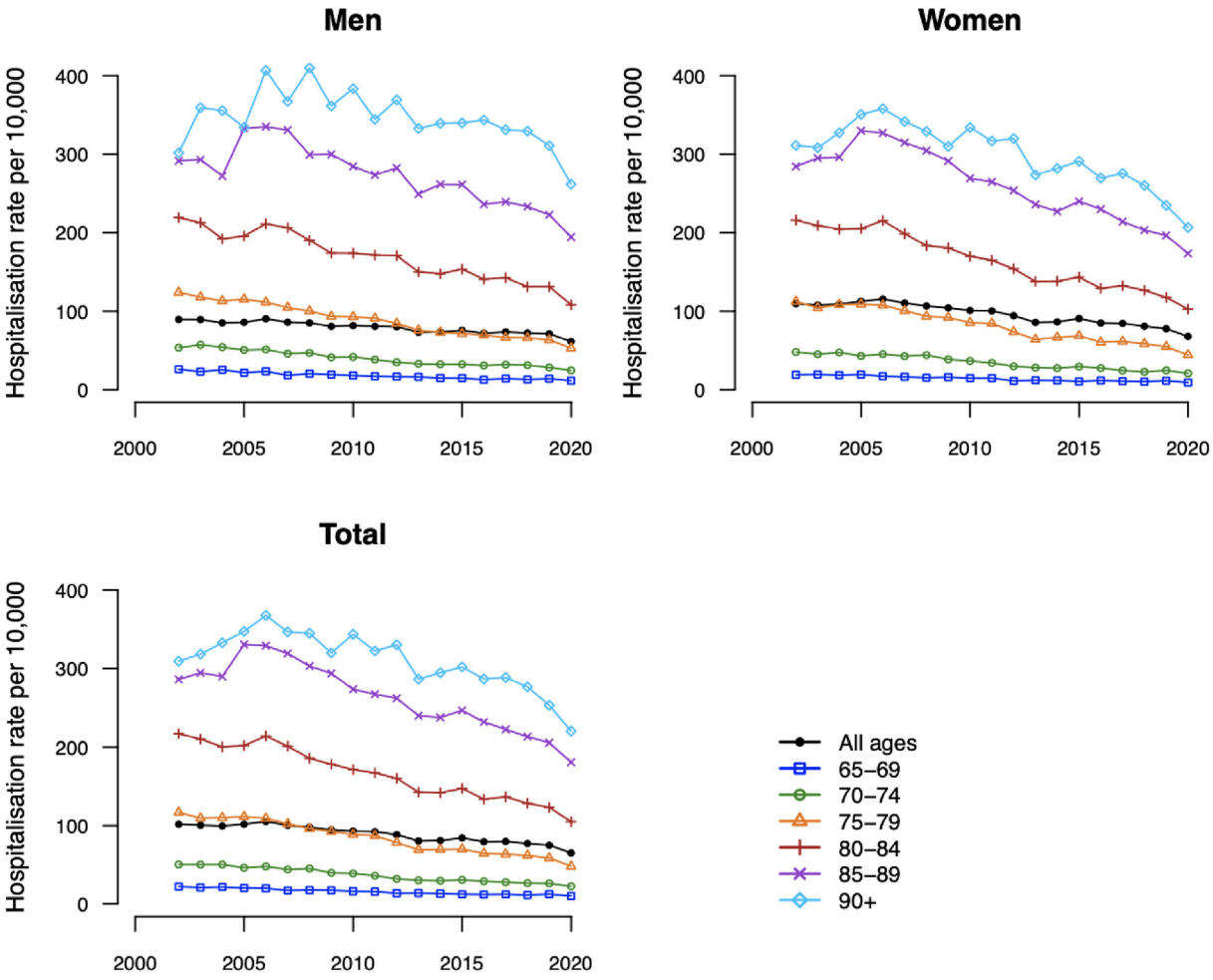

Fig. 1. Hospitalisation trends overall, by sex and by age group in years, over the period 2002–2020.

that these policies were effective at avoiding potential unnecessary admissions of people with sub-acute or chronic conditions. Indeed, these political strategies, together with the establishment of the memory clinics and the national policies implemented over these years,[18] probably led people to primarily access outpatient services, leaving hospital admissions solely for people with dementia at increasingly late and complex phases of the disease. However, further study on clinical outcomes of people with dementia will be important to evaluate the impact of these policies on the quality of care provided and clinical outcomes.

In terms of the causes of hospitalisation, heterogeneous patterns were reported in the literature. Data from the Global Burden of Disease Study showed that chronic RSPs in the general population were slightly decreasing during recent decades,[21] while upper respiratory infections in Europe, gender- and age-standardised, remained stable.[22] Even a previous US study based on hospital discharge data identified CVDs as the major contributors to hospitalisations during the last two decades, among both people with no age restrictions and those aged ≥65 years.[23,24] The results of the current study, based on a large population registry of about 350,000 hospitalised individuals aged ≥65 years with dementia, are consistent with a previous systematic review published in 2013[25] that reported people with dementia had a higher risk of hospitalisation for RSP and for all-cause infections. The current study findings suggest a different health-status profile for older people with dementia than those without dementia and highlight the impact of RSPs on this specific population, even before the COVID-19 pandemic. Future prevention campaigns for RSPs, especially for infectious pneumonia, and via out-of-hospital care disease management, will lead to clinical benefits for patients and sustainability for the National Health Service, by preventing avoidable admissions to hospital. Indeed, among the causes of hospitalisations identified in the current study, many were preventable diseases according to the Ambulatory Care Sensitive Conditions (ACSC),[26] which would need further investigations for identifying innovative strategies to implement across the clinical pathway for dementia. In particular, infectious pneumonia, heart failure and urinary tract infections represent preventable causes of hospitalisation, according to almost all the ACSC frameworks,[27] and are the most frequent leading causes of hospitalisations among people with dementia.

In terms of gender differences, several studies have shown that women have a longer life expectancy and average age of dementia diagnosis, in addition to other hypothetical differences in biology and social factors.[4,28–30] However, one study reported that, over the past 25 years, the incidence of dementia was similar for men and women in high-income countries.[31] As previously mentioned, the current findings highlighted a different pattern in hospitalisation rates between the sexes, with a higher rate for men with dementia. Furthermore, sex differences were also present among causes of hospitalisation. The present study showed a sharp difference by sex of traumatic pathologies as causes of hospitalisation; indeed, women were twice as likely to be hospitalised as a result of TRM than men,

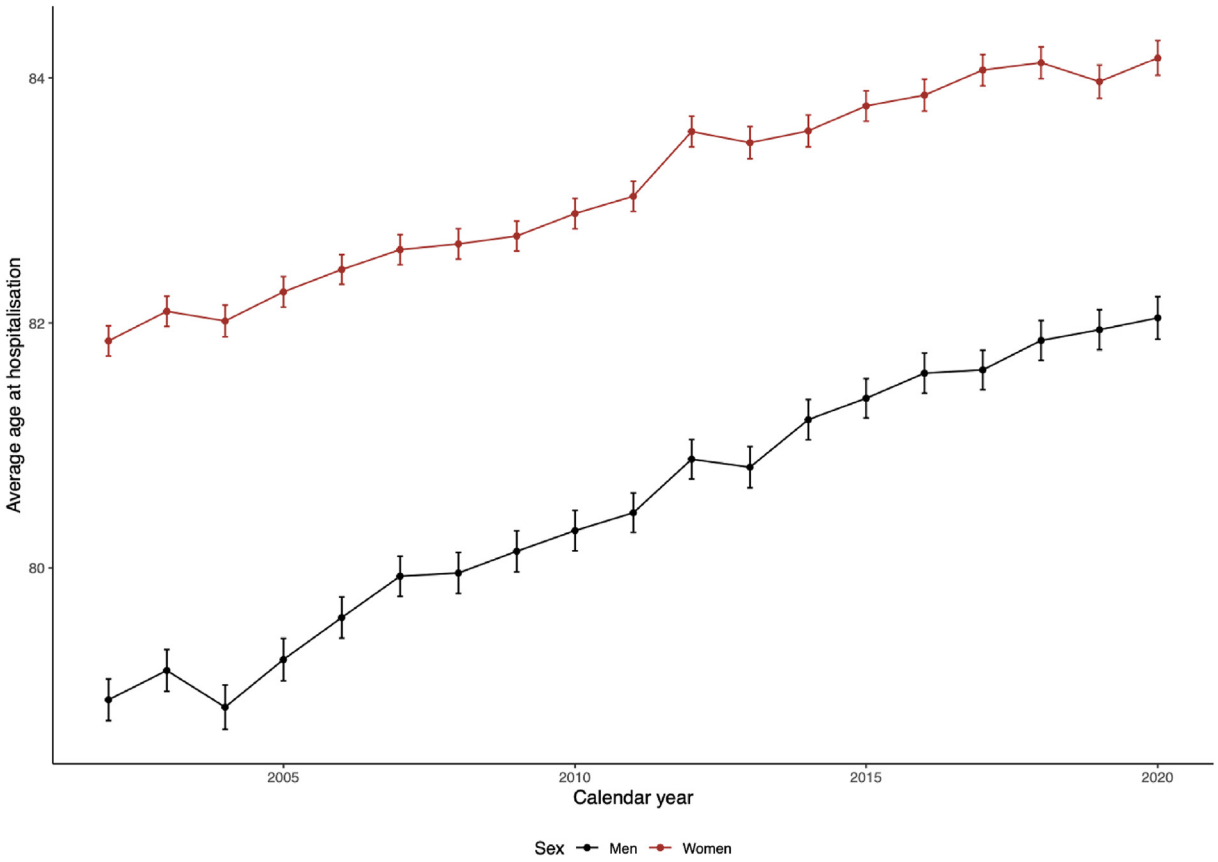

Fig. 2. Trends of mean age of hospitalised people with dementia by sex, over the period 2002–2020. Error bars represent the 95% confidence intervals for mean ages.

Table 2
Hospitalisations percentages among hospitalised people with dementia by six leading causes, over the period 2002–2020.

Cause of hospitalisation	2002–2004 (%)	2010–2014 (%)	2015–2019 (%)	2020 (%)	2015–2019 vs 2010–2014 (% difference)	2020 vs 2015–2019 (% difference)
CVD	19.2	17.4	17.0	15.7	−2.12	−7.59
RSP	10.4	13.7	17.0	26.8	23.98	57.87
TRM	8.3	9.9	9.3	8.2	−6.08	−11.66
GI	5.4	4.3	3.9	3.2	−9.62	−18.76
GU	3.4	4.6	6.8	7.2	45.62	6.20
ONC	3.2	2.4	1.9	1.8	−20.36	−8.04

CVD, cardiovascular disease; RSP, respiratory disease; TRM, trauma; GI, gastrointestinal disease; GU, genitourinary disease; ONC, oncological disease.

and this trend remained stable during the last two decades. These results can be used to strengthen and target prevention strategies, especially for accidental falls, which expose patients to severe health hazards. Indeed, people with dementia may have problems in performing physiotherapy rehabilitation; therefore, this phenomenon has a more serious impact on the health of this population.[32] Multiple studies have focused on the accidental falls of elderly patients, and female sex was shown to have a risk of hip fractures that was 2.9 times higher[33,34] than for men. The current study showed that hospital admissions as a result of TRM were mainly due to hip fractures. The results also highlighted that hip fractures occurred only two times more frequently in women with dementia (compared to 2.9 times as reported for the general population), suggesting that the risk of falls is related to sex changes among older people with dementia and hypothetically increases for men. The sex differences should be further investigated in future studies.

The present study has some limitations. Firstly, the use of the ICD9-CM coding system could be different among clinicians, who could code a case of dementia differently. Secondly, it is possible that there could be an under-coding phenomenon, underestimating the number of discharges of people with dementia.[35] Thirdly, the clinical definitions of some dementia conditions, especially Alzheimer's disease, have evolved over time, thus leading to a change of criteria in the case definition.[8] Finally, the current analysis did not account for differences in healthcare-seeking behaviour, access to hospital care or general hospitalisation rates, which could introduce biases in the observed hospitalisation rates for dementia. However, the findings of this study provide information about serious illnesses requiring acute care, which depend, to a less extent, on health-seeking behaviours.

This study also presents many strengths. The definition of dementia as a syndrome has remained relatively constant.[31] The discharges of people aged <65 years were not included to avoid bias due to different coding of young-onset dementia and different clinical pathways. In addition, a nationally standardised case definition was used, based on the international literature. To better evaluate hospitalisation trends, data related to the year 2021 were excluded because local health policies, in response of the COVID-19

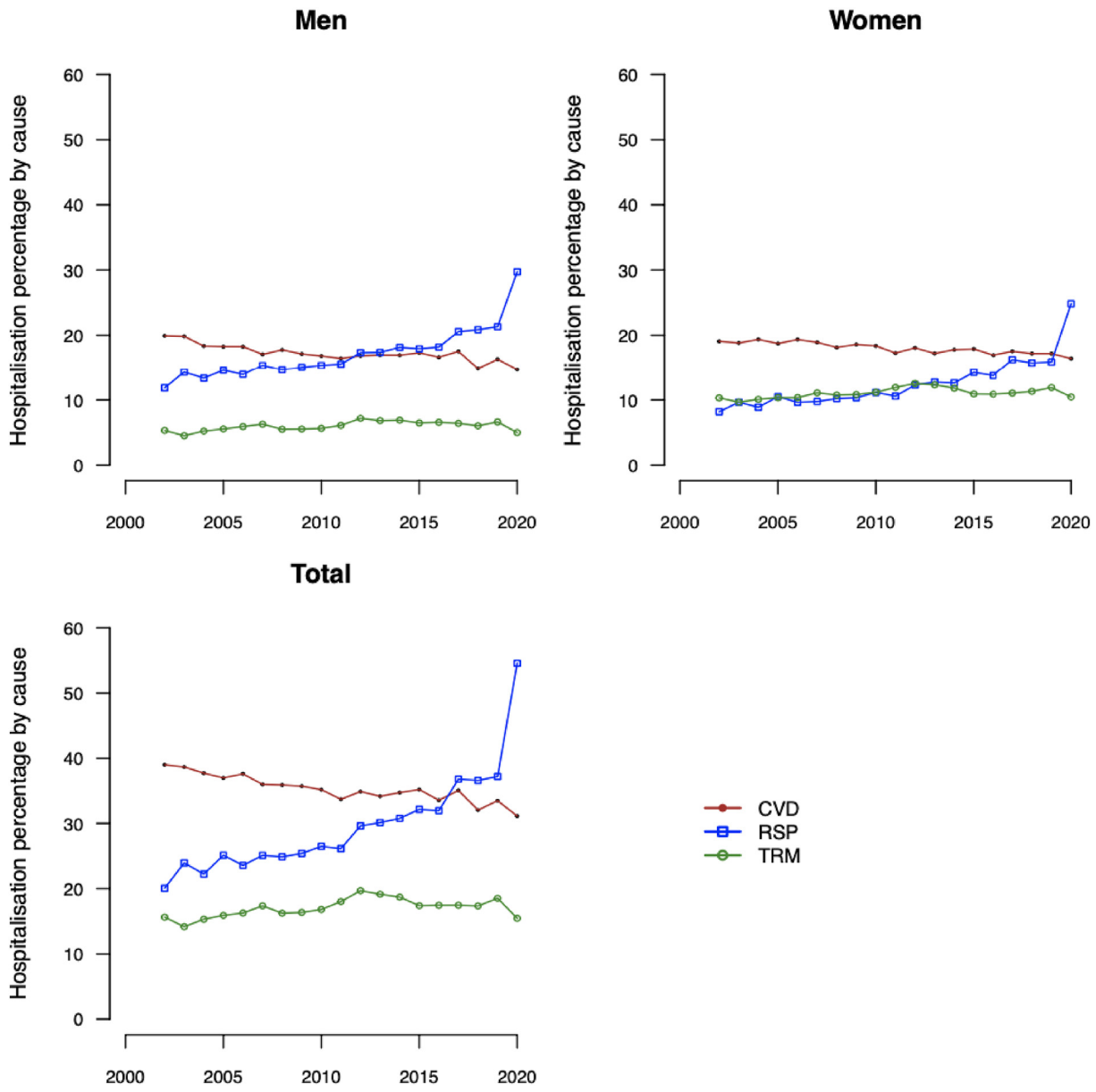

Fig. 3. Hospitalisation trends of people with dementia by leading hospitalisation causes, by sex (proportions). Over the period 2002–2020. CVD, cardiovascular disease; RSP, respiratory disease; TRM, trauma.

Table 3
Leading illness/condition per main cause of hospitalisation among hospitalised people with dementia, over the period 2002–2020.

Ranking	RSP	CVD	TRM	GI	GU	ONC
1	Pneumonia, organism unspecified	Left heart failure	Late effect of fracture of neck of femur	Intestinal obstruction	Urinary tract infection	Malignant neoplasm of bladder
2	Food/vomit pneumonitis	Acute cerebrovascular insufficiency unspecified	Closed fracture of epiphysis of neck of femur	Cirrhosis of liver	Acute kidney failure	Malignant neoplasm of bronchus and lung
3	Acute respiratory failure	Cerebral thrombosis with infarction	Closed fracture of trochanteric section of neck of femur	Acute pancreatitis	Chronic kidney disease	Malignant neoplasm of liver

CVD, cardiovascular disease; RSP, respiratory disease; TRM, trauma; GI, gastrointestinal disease; GU, genitourinary disease; ONC, oncological disease.

pandemic, could lead to a heterogeneous impact on the regional attitude to hospitalisation. On the other hand, discharge data related to the year 2020 were included in order to observe the impact of the COVID-19 pandemic on the hospitalisation of this population group. Finally, the major strength of this study is that it analysed data from all of the hospitalised older patients (aged ≥65 years) in the Lombardy region, the most populous Italian region with about 10 million individuals, over a time period covering two decades, including the year when the COVID-19 pandemic started. Thus, the results of this study provide a solid description of the hospitalisation trends, classified by leading causes of admission, for people with dementia in a high-income area.

This study provides new insights into the trends of hospitalisation by leading causes, offering a reliable report of when, why and how people with dementia accessed the hospital setting. The findings give new knowledge on this specific population, revealing sharp differences by sex and a high impact of infectious diseases during the last two decades. This study highlights the burden of the most frequent diseases that lead to hospitalisation of people with dementia. Among those leading causes, a multitude of preventable diseases were identified. Additional preventive strategies for this specific population profile are required, especially those related to infectious diseases and traumatic pathologies. Thus, policymakers should consider implementing tailored interventions for dementia. On the basis of the current study findings, future research should focus on sex differences in hospitalisation patterns and the sharp increase of acute RSPs for people with dementia compared with people without dementia. Moreover, considering the change in hospitalisation trends over the study period, researchers should focus on the long-term impacts of health policies on health outcomes for people with dementia.

Author statements

Ethical approval

None required.

Funding

None declared.

Competing interests

The authors declare no competing interests.

Data sharing

The region-wide and highly sensitive data used were made available only within the highly protected environment of the research facilities in the Lombardy region. Enquiries about secure access to data under conditions stipulated by the Lombardy region should be directed to the corresponding author.

Contributors

LB and PB conceptualised and designed the study, carried out the formal analyses and data management, and wrote, reviewed and revised the manuscript. PB assisted in study design and data management, and carried out the formal analyses and reviewed and revised the manuscript. AO, TC and HB reviewed and revised the manuscript for important intellectual content. All authors had full access to the data in the study, approved the final manuscript as submitted, agreed to be accountable for all aspects of the work and decided to submit the manuscript. LB and PB directly accessed and verified the underlying data reported in the manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2023.06.036.

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