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Original Research Article

A 22-year study to evaluate disparities in place of death in the United States using the CDC WONDER database for intracerebral hemorrhage

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ABSTRACT

Background: Interpretation of data collected from the CDC WONDER database and analysis of disparities in places of death for those patients diagnosed with intracerebral hemorrhage (ICH) in the United States from 1999 to 2020. Our research intends to uncover important insights into potential differences in end-of-life care for patients suffering from ICH and to provide solicited care during this crucial time.
Methods: We conducted an epidemiological study in which all patient-specific demographics were extracted from the CDC WONDER database evaluated for disparities in place of death, and compared based on variables. The odds ratio was also calculated. Qualitative data was expressed in percentage and proportion, whereas statistical analysis was done using R programming software.
Results: Data of 18,783,791 ICH deaths was aggregated. Data explained that patients in the 85+ age group are the most likely to die at home, and this particular age group also has seen the highest number (1,941,657) of fatalities in home or hospice and the highest number (4,937,395) of fatalities in medical or nursing facilities. Male patients in the 55–64 age group were most likely to die at home or hospice, whereas female patients in general were most likely to die in medical or nursing facilities. West census region patients were 1.424 times more likely to die at home or hospice, this number being the highest of all regions.
Conclusions: Home or hospice mortality trend in patients with ICH, within a 22-year period, increased significantly, specifically in white male patients ages 85 and older from the west rural region.

Keywords: Demographic disparity, Hospice care, Healthcare disparity, ICH, Death

INTRODUCTION

Death is the permanent cessation of functioning of the organism as a whole, and its sole criterion is the total and irreversible loss of functioning of the whole brain.[1] End-of-life care describes the support and medical care given during the time surrounding death.[2]

The most common places of death are at home, the hospital, or a care facility. End-of-life care at home is one of the most private settings, and it allows for family and friends to come and go freely. It also may give the person who is dying a sense of comfort. In a hospital setting, the patient has access to medical professionals who understand the needs of a dying person, which can be very reassuring to both the person and their family. In addition to the regular care team, some hospitals have palliative and hospice care teams that can assist with managing uncomfortable symptoms at the end-of- life. Many end-of-life patients are in care facilities, such as nursing homes or other long-term care facilities, where a nursing staff is always present and the care may be more personalized than in a hospital.[3]

Non-traumatic ICH is a stroke subtype with high mortality and poor functional outcomes in survivors. Its main causes are hypertension, cerebral amyloid angiopathy, and anticoagulant treatment.[4] It has a high early case fatality which reaches 40% in some population-based studies. Predictors of early mortality include age, severity of neurological impairment, hemorrhage volume, and antithrombotic therapy at the time of the event.[5]

A similar study on the mortality rates of ICH in 2017 showed an overall incidence of 24.6 per 100.000 patient years, which is considerably higher in Asian populations. Despite the progress in acute interventions and a great increase in clinical studies over the previous decade, mortality of ICH remained high and survivors remained at increased risk of recurrent hemorrhagic as well as ischemic stroke.[6]

Aim and objectives

The primary objective of this study is to assess and analyze the disparity in the place of death among patients diagnosed with ICD-11 code 161 (ICH) in the United States, focusing on three key parameters: age, gender, and US Census region (Northeast, Midwest, South, and West regions). The study was conducted by utilizing data from the CDC WONDER database spanning 1999 to 2020. Our research aims to seek valuable insights into potential discrepancies in end-of-life care, thereby contributing to a better understanding of factors that influence decisions about the place of death. In addition, it will help facilitate the development of targeted interventions and policies to improve end-of-life care, aligning with the fundamental sense of humanity in providing compassionate care during this critical phase of a patient's life.

METHODS

Study type and study place

The present study is a cross-sectional analytical type, and utilized data from the CDC WONDER (Centers for disease control and prevention wide-ranging online data for epidemiologic research) database on 15 July 2023. The CDC is the primary public health institution in the U.S. CDC WONDER is a system of searchable databases with access to a wide array of public health indicators. Information provided by the database includes the place of death as well as patient-specific demographics including age, sex, race and U.S. census region.

Data selection

The CDC WONDER underlying cause of death database was queried for people who died from ICH between 1999 and 2020. During the data collection process, strict measures were taken to ensure the anonymity of all reported cases, and no attempt was made to determine the identity of any individual. Patient characteristics were collected which include year of death, place of death, age, sex, race, U.S. census region (Northeast, Midwest, South, West) and cause of death based on ICD code I61 (ICH).

During selection, age was selected as a 10-year group and all gender and races were selected. Data was grouped into three categories (home or hospice, medical facility, and others) based on place of death, and each demographic variable was compared in each category. Then odds ratio was calculated so as to compare each age group, gender, and place of death.

Statistical analysis

All data was exported to MS excel and qualitative data was expressed as percentages and proportions. Statistical analysis included univariate logistic regression and was done using R programming software. Furthermore, the trends in death rates in home or hospice over the study period were also examined to gain insights into the temporal patterns of mortality in the studied population.

Ethical approval

As all data was sourced from the CDC-WONDER database, which is publicly accessible and free to use, the study was deemed exempt from ethical approval.

RESULTS

Aggregate data of a total of 18,783,791 deaths from 1999–2020 (inclusive) was obtained for ICH from the CDC WONDER database.

Table 1 shows the total number of deaths in 3 categories: home or hospice death, medical or nursing facility, and others. In 10-year age groups, we observed that the minimum number of deaths in home or hospice was in the 1-4 years group (n=446). The maximum number of deaths was in the 85+ age group (n= 1,941,657). In the case of medical or nursing facility deaths, the minimum number of deaths was reported to be in the 1-4 years age group (n=4,227) and the maximum number of deaths was

in the 85+ age group (n=4,937,395). In the others category, we saw that the 1-4 age group had the least number of deaths, and the most number of deaths was seen in the 85+ age group.

Based on gender, there were 2,860,358 male and 2,521,656 female home or hospice deaths. In the medical or nursing facility there were 6,652,392 female deaths and 5,901,317 male deaths. The others category had more male deaths compared to female deaths.

According to the census region, the minimum number of home or hospice deaths was 935,833 in the Northeast, while the maximum was 2,123,684 deaths in the South region. The least number of medical or nursing facility deaths was 2,207,697 in the West and the most number of deaths was 4,595,317 in the South. In the others category, the Northwest showed the least deaths and the South showed the most deaths.

Table 2 shows predictors of home or hospice death in cases of ICH. On univariate logistic regression analysis of the aggregate data (1999-2020), it was observed that patients aged 55-64 years were most likely to die at home or hospice. Male patients were more likely to die at home. According to census regions, patients in the West were most likely to have a home or hospice death. Considering age group <1 year as reference, patients aged 55-64 years were 8.609 times more likely to die at home or hospice. Considering females as reference, males were 1.262 times more likely to have a home or hospice death. Considering the northeast census region as reference, patients in the West were 1.424 times more likely to die at home or hospice.

Table 1: Place of death.

Variables	Home or hospice, (n=5382014)	Medical facility or nursing, (n=12553709)	Others, (n=848068)
Ten-year age groups			
<1	661	10810	161
1-4	446	4227	82
5-14	745	6101	153
15-24	5702	21137	1895
25-34	24696	63155	6717
35-44	94969	210342	23386
45-54	320681	592610	66076
55-64	660348	1169665	103499
65-74	922777	1975866	110249
75-84	1408926	3562048	183091
85+	1941657	4937395	352564
Gender			
Female	2521656	6652392	406270
Male	2860358	5901317	441798
Census region			
Census region 1: Northeast	935833	2678051	86909
Census region 2: Midwest	1154314	3072644	166696
Census region 3: South	2123684	4595317	378961
Census region 4: West	1168183	2207697	215502

Table 2: Predictors of home or hospice death.

Variables	Univariate logistic regression		
	Odds ratio	**95% CI**	**P value**
Age (in years)			
< 1	1.000 (Reference)		
1-4	1.718	(1.516, 1.947)	<0.001
5-14	1.977	(1.773, 2.205)	<0.001
15-24	4.109	(3.779, 4.468)	<0.001
25-34	5.866	(5.416, 6.354)	<0.001
35-44	6.744	(6.233, 7.297)	<0.001
45-54	8.081	(7.47, 8.741)	<0.001
55-64	8.609	(7.958, 9.312)	<0.001
65-74	7.342	(6.787, 7.942)	<0.001
75-84	6.244	(5.772, 6.754)	<0.001
85+	6.092	(5.632, 6.59)	<0.001

Continued.

Variables	Univariate logistic regression		
	Odds ratio	95% CI	P value
Gender			
Female	1.000 (Reference)		
Male	1.262	(1.26, 1.265)	<0.001
Census region			
Census region 1: Northeast	1.000 (Reference)		
Census region 2: Midwest	1.053	(1.05, 1.056)	<0.001
Census region 3: South	1.261	(1.258, 1.265)	<0.001
Census region 4: West	1.424	(1.42, 1.429)	<0.001

Figure 1 depicts the overall home or hospice death trends in ICH patients from 1999-2020 as a gradually increasing trend. Figure 2 shows home or hospice death trends based on age. The study showed that patients in the 85+ age group were most likely to die at home and had an increasing trend, whereas the trends in age groups <1 year to 54 years were fairly constant. Figure 3 shows home or hospice death trends according to gender, which reports that males were more likely to die at home compared to female patients. According to Figure 4, patients in the white population showed highest mortality trend of home or hospice death compared to other races, likely due to population demographics. Figure 5 shows that patients were most likely to die a home or hospice death in south census region compared to other regions.

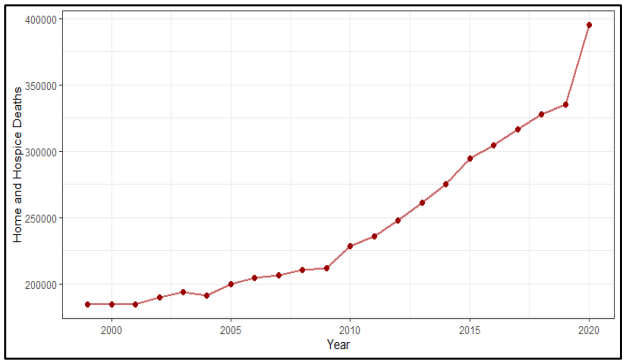

Figure 1: Overall trends in mortality in home or hospice.

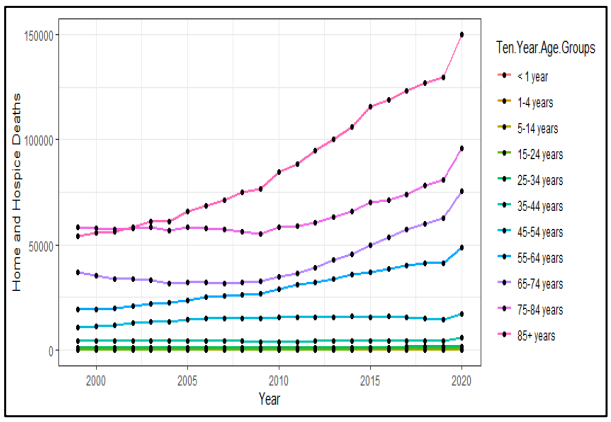

Figure 2: Trends in mortality in home or hospice, based on age groups.

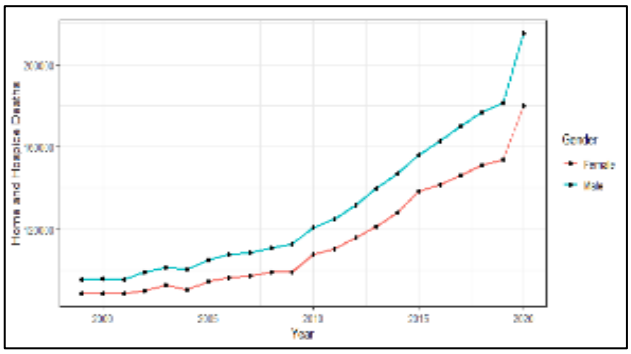

Figure 3: Trends in mortality in home or hospice, based on gender.

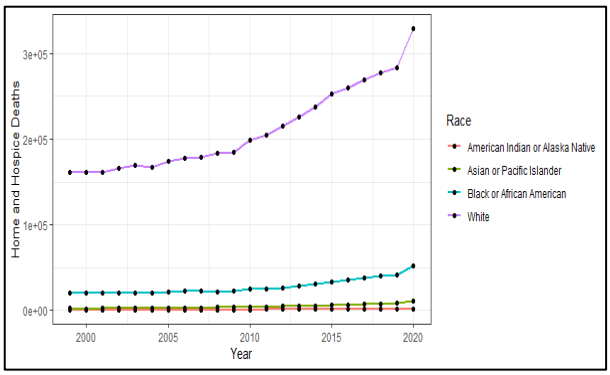

Figure 4: Trends in mortality in home or hospice, based on race.

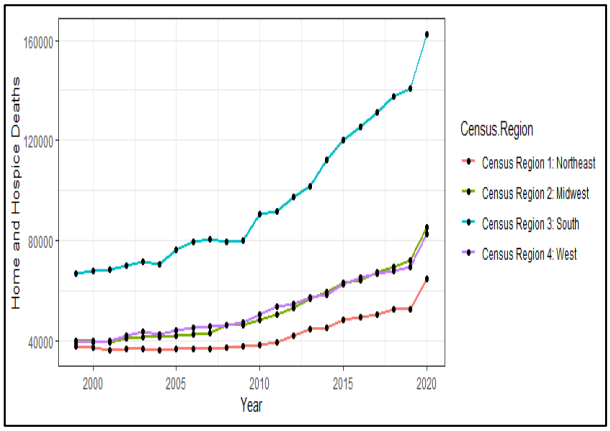

Figure 5: Trends in mortality in home or hospice, based on census region.

DISCUSSION

We undertook a detailed analysis of mortality trends related to ICH over a period of 22 years. This extensive study was made possible by drawing upon data accumulated from the CDC WONDER database.

ICH is a very important topic to analyze and discuss, since it is the form of stroke with the highest mortality and it accounts for approximately 10% of all strokes, with an incidence rate of 0.1-0.3/1,000/year.[7,8]

Overall, we discovered that there were approximately 5,382,014 deaths recorded within the confines of home or hospice care. A more substantial number, amounting to 12,553,709, were reported in medical or nursing facilities. Meanwhile, other settings witnessed a total of 848,068 deaths.

When these deaths were assessed based on age groups, we observed that the group aged 85 years and above demonstrated the highest number of fatalities. This trend was consistent regardless of the setting-be it in home or hospice care, medical or nursing facilities, or any other location categorized as a place of death.

Upon analyzing the data through the lens of gender, we found that the number of deaths did not differ significantly between females and males, although females presented slightly higher numbers. It's worth noting that the data shows an interesting distribution: At in-home or hospice care settings and in other settings, males had a higher number of deaths. On the other hand, medical or nursing facilities reported more female deaths.

From a geographical perspective, the South Region demonstrated a significantly higher number of deaths in comparison to other regions. This pattern held true across all different categories of places of death. Thus, it seems the South was more adversely affected by cases of ICH mortality over the course of these 22 years.

The present study depicts the findings of the univariate logistic regression with respect to age, gender, and census regions. Starting with age, it is clear that the odds of death at home or in hospice care increase significantly with age. The reference point is set at the <1 year age group. As we progress to higher age groups, the odds ratios tend to be higher, going from 1.718 in the 1-4 years group up to 8.609 in the 55-64 years group. However, beyond the 65-74 years group, there is a gradual decline in the odds ratio, reaching 6.092 for the 85+ group. Despite this mentioned decline, there is still a statistically significant difference between the reference group (<1 year) and the rest of the groups. This indicates that the risk of home or hospice death due to ICH is significantly higher in older age groups. This decline might be explained by multiple factors: As people grow older, they may face multiple health issues which require them to need regular and specialized care, which in turn could increase their likelihood of being in a medical or nursing facility at the time of death. This is supported by the findings by Rincon, which stated higher admission rates in patients above 65 years old.[9] Furthermore, in this age group, because of health issues, they might be inclined to live in assisted living or nursing homes. This decline could also be explained by Pedersen's findings, which showed a lower incidence rate of ICH in individuals over 70 years old.[10] We must also consider that the trend and projections indicate an increasing number of people over 65 years old. Stein's study further supports this, concluding that mortality from ICH was significantly higher in patients over 80 years old.[11]

In terms of gender, males were found to have a 26.2% higher chance of death at home or in hospice settings compared to females, with an odds ratio of 1.262. This was a similar finding to what Wang reported in Tianjin, China.[12] This was also supported by his study, which found a death ratio for males of 25.67/100,000 and females of 19.17/100,000.[13]

Geographically, when comparing census regions, the Northeast served as the reference group. The data showed that there were increased odds of home or hospice death in other regions. The Midwest had a slightly elevated risk, but the South and the West had notably higher odds, with ratios of 1.261 and 1.424, respectively. These regional disparities indicate a heightened risk in certain geographical areas that warrants further investigation. This might correlate with Wang's findings where there was a higher mortality rate in rural areas compared to urban areas, emphasizing the potential role of access to healthcare, lifestyle differences, and socioeconomic factors[12]. These findings were similar to Otite's, which concluded that patients hospitalized in rural hospitals had double the odds of dying from ICH than patients in urban hospitals. This was explained by the fact that mortality in urban hospitals has been decreasing on average by 2.8% each year, while rates in rural hospitals have not changed significantly.[14]

If we analyze the data of deaths in home or hospice care each year, we can see that the total number of deaths have increased throughout the years, almost 4 times. This is very different from what Wang reported in the study from Tianjin, China, where there was actually a decrease in mortality rates from 1999 to 2015.[12] Similarly, Darin reported a decrease from 2000 to 2010, especially in the 45-59 age group.[15]

Limitations

The latest data from 2021-2023 is not included, and we did not classify the disease intracerebral hemorrhage based on sub-categories of primary and secondary intracerebral hemorrhage. Future studies can be done when the data is available and can be done through classifying based on subcategories.

CONCLUSION

We conclude that there is a rise in home and hospice deaths due to intracerebral hemorrhage from the years 1999 to 2020. An increased number of deaths were found in male patients, those in the white population and those in the 85+ age group. Maximum home and hospice deaths are found in the South. In the case of medical and nursing facility deaths due to ICH, increased numbers are found in the 85+ age group, the female gender, the white population, and in the South.

Future measures should be taken to find out the reason for the prevalence and cause of home and hospice death in the above-mentioned groups. Measures should be taken to improve end-of-life care for patients.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Bernat JL, Culver CM, Gert B. On the definition and criterion of death. Ann Intern Med. 1981;94(3):389-394.
2. Froggatt K, Payne S. A survey of end-of-life care in care homes: issues of definition and practice. Health Social Care Community. 2006;14(4):341-8.
3. Zimmerman S, Sloane PD, Hanson L, Mitchell CM, Shy A. Staff perceptions of end-of-life care in long-term care. J Am Med Dir Assoc. 2003;4(1):23-6.
4. Kase CS, Hanley DF. Intracerebral Hemorrhage: Advances in Emergency Care. Neurol Clin. 2021;39(2):405-18.
5. Pinho J, Costa AS, Araújo JM, Amorim JM, Ferreira C. Intracerebral hemorrhage outcome: A comprehensive update. J Neurol Sci. 2019;398:54-66.
6. Weimar C, Kleine-Borgmann J. Epidemiology, Prognosis and Prevention of Non-Traumatic Intracerebral Hemorrhage. Curr Pharm Des. 2017;23(15):2193-6.
7. Otite FO, Khandelwal P, Malik AM, Chaturvedi S, Sacco RL, Romano JG. Ten-Year Temporal Trends in Medical Complications After Acute Intracerebral Hemorrhage in the United States. Stroke. 2017;48(3):596-603.
8. Carlsson M, Wilsgaard T, Johnsen SH. Temporal Trends in Incidence and Case Fatality of Intracerebral Hemorrhage: The Tromsø Study 1995-2012. Cerebrovasc Dis Extra. 2016;6(2):40-9.
9. Rincon F, Mayer SA. The epidemiology of intracerebral hemorrhage in the United States from 1979 to 2008. Neurocrit Care. 2013;19(1):95-102.
10. Pedersen TGB, Vinter N, Schmidt M. Trends in the incidence and mortality of intracerebral hemorrhage, and the associated risk factors, in Denmark from 2004 to 2017. Eur J Neurol. 2022;29(1):168-77.
11. Stein M, Misselwitz B, Hamann GF, Scharbrodt W, Schummer DI, Oertel MF. Intracerebral hemorrhage in the very old: future demographic trends of an aging population. Stroke. 2012;43(4):1126-8.
12. Wang DZ, Xue XD, Zhang H, Xu ZL, Zhang Y, Song GD, et al. The trend of intracerebral hemorrhage mortality of the residents with different characteristics in Tianjin, China, 1999-2015. Zhonghua Yu Fang Yi Xue Za Zhi. 2018;52(4):389-95.
13. DeLago AJ Jr, Singh H, Jani C, Arashdeep R, Joseph S, Richard G, et al. An observational epidemiological study to analyze intracerebral hemorrhage across the United States: Incidence and mortality trends from 1990 to 2017. J Stroke Cerebrovasc Dis. 2022;31(4):106216.
14. Otite FO, Akano EO, Akintoye E, Priyank K, Amer MM, Seemant C, et al. Rural-Urban Disparities in Intracerebral Hemorrhage Mortality in the USA: Preliminary Findings from the National Inpatient Sample. Neurocrit Care. 2020;32(3):715-24.
15. Zahuranec DB, Lisabeth LD, Sánchez BN, Melinda AS, Devin LB, Nelda MG, et al. Intracerebral hemorrhage mortality is not changing despite declining incidence. Neurology. 2014;82(24):2180-6.

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