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# Ischemic Stroke, Risk Factors and Hospitalization Costs: Variation by Age and Gender in California

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## Abstract

**Objectives:** We examine variations in ischemic stroke prevalence, risk factors and hospital costs by age and gender among young, mid-age, and elderly patients. Based on the Women's Health Study and other research, we wondered whether ischemic stroke be gender dominant at older ages, in part, because of loss of protective pre-menopause mechanisms in the elderly.

**Methods:** Patients (aged 20+) from 2010 California hospital discharge data system (HDDS) were examined with a primary diagnosis of stroke (ICD-9 code 430-438; n = 9,770; average age 76; females 52%) along with their demographics, co-morbidities, and hospital costs. Specific prevalences according to age (20 - 50, 51 - 64, and 65+ years), gender, risk factors and hospital costs were analyzed.

**Results:** The overall prevalence of stroke was 4.2%, and it increased significantly with increasing age from 3.0% among 20 - 50 years to 3.3% among 51 - 64 years, to 4.5% among the elderly (65+ years). While the proportion of stroke was equal among males and females in the younger and mid-age groups, stroke was more prevalent among elderly females than males (4.6% vs. 4.4%, $p < .01$). Risk factors across all three age groups included hypertension, hyperlipidemia, coronary heart disease, and atrial fibrillation. Further, diabetes mellitus existed as a risk factor only for the elderly females. Finally, the average cost for stroke alone was $80,696 and it covered over 50% of the total cost of the year. Stroke cost was higher for males ($88,057) and younger patients of both genders ($127,370) compared to patients in other groups due largely to longer hospitalization.

**Conclusion:** Stroke is more prevalent among hospitalized younger and mid-age males while it is higher among elderly females. Further, higher hospital costs among the younger patients reflect the burden of co-morbid conditions, and possibly surgical procedures involving brain swelling which is more of an issue with young stroke patients. Prospective studies are warranted to assess whether proven preventive programs aimed at these risk factors among younger individuals could reduce stroke morbidity and hospital costs.

***Keywords:*** *Stroke; Gender; Young; Mid-Age; Elderly; Hospital Cost*

## Background

More than 795,000 adult men and women experience stroke each year, producing an estimated healthcare cost of $34 billion per year [1]. Stroke prevalence varies according to age, sex, and race. In general, stroke prevalence is higher among older individuals, among males, and those in the minority groups, and 88% of all stroke is classified as ischemic rather than hemorrhagic [1-4].

Previous studies have pointed to the importance of various stroke risk factors, including hypertension (HTN), diabetes mellitus (DM), hyperlipidemia, coronary heart disease (CHD), atrial fibrillation (AFib), obesity, dementia, and depression. Previous studies show that these risk factors vary by gender and age [5-11]. For instance, stroke prevalence was generally low (3% - 4%) among young adults (aged < 50 years) and their risk factors included hypertension, smoking, dyslipidemia, alcohol abuse, and drug abuse [12-23]. In contrast, the middle age group (51 - 64 years old), had risk factors that included hypertension, coronary heart disease, AFib, family history, alcohol abuse and smoking [24,25] and the elderly group (65+ years old), was characterized by hypertension, diabetes mellitus, coronary heart disease, atrial fibrillation, obesity, and dementia [26-32].

While we examine the traditional cardiovascular risk factors that persist through the life cycle, what remains unknown is their variation by gender within each age group along with variations in healthcare costs per year. Thus, this paper examines data on California stroke patients regarding variations in stroke prevalence, risk factors, and hospital costs by age and gender.

## Methods

### Sample

We obtained the year 2010 administrative files of Hospital Discharge Data System (HDDS) from the California's Office of Statewide Health Planning and Development (OSHPD) on patients (aged 20+; n = 234,465). From this cohort, we selected patients with a primary diagnosis of stroke (ICD-9 codes 430-438; n = 9770, mean age 76 (SD = 13.48), females 52%) along with their demographics (age, sex), co-morbid conditions as secondary diagnosis, number of hospital admissions, length of stay (days), and hospital charges (submitted cost in USD) for each discharge in 2010. The sample had 62% whites, 18% Hispanics, 12% African Americans, and 8% Asian/Pacific Islanders, and it also included 3.2% of patients with a diagnosis of hemorrhagic stroke which was distributed as 1.9%, 1.7%, and 3.5% among the three age groups respectively.

For each patient, two indices of co-morbidity were computed: (i) a simple count of all secondary diagnoses that were identified by ICD-9-CM codes; and (ii) Charlson [33] Index of co-morbidity severity. Further, two measures of cost were developed: (1) cost for 1st stroke discharge, and (2) total cost for the same patient that included the hospital charges for 1st stroke discharge plus the charges (cost) for other discharges with different diagnoses during 2010.

**Statistical analysis:** Differences between stroke and non-stroke patients as well as the prevalence of stroke, risk factors by sex within each age category, were all evaluated with logistic regression models, Pearson $\chi^2$ and the Fisher's Exact Tests. Cost differences between groups were evaluated with ANOVA.

## Results

### Stroke prevalence and risk factors by age and gender

Overall 4.2% of all patients had stroke, and stroke prevalence was higher among the Elderly (E) compared to Mid-age (M) and Younger (Y) groups (E:M:Y; 4.5% vs. 3.3% vs. 3.0%%, p < .001, table 1, cols. 3 - 5). Further, in all three age groups, stroke was associated (p < .001) with HTN, hyperlipidemia, CHD, and AFib (E:Y:M; table 1, odds ratios, cols, 6 - 8). As expected, dementia was associated with stroke only among Mid-age and Elderly groups (Table 1, cols, 7 - 8).

| | | Stroke | --> | --> | --> | OR/CI | OR/CI→ | OR/CI→ | All stroke |
|---|---|---|---|---|---|---|---|---|---|
| Variables | No-Stroke | ALL Stroke | Young | Mid-age | Elderly | Young | Mid-age | Elderly | Patients OR/CI |
| Cols → | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| N- ---> | 224,695 | 9,770 | 536 | 1389 | 7845 | ---- | ----- | ---- | 9770 |
| Stroke % | ------ | 4.2 | 3.0 | 3.3 | 4.5 | ---- | ----- | ------ | |
| HTN % | 81 | 90* | 83 | 90* | 90 | 2.16*/1.69-2.76 | 2.56*/2.12-3.08 | 2.05*/1.8-2.22 | 2.14*/2.0-2.3 |
| DM % | 42 | 44 | 42 | 56* | 42 | 1.00/.83-1.21 | 1.08/.97-1.22 | 1.06+/1.01-1.22 | 1.06*/1.02-1.11 |
| Chol % | 9 | 12* | 10 | 12 | 12 | 1.44*/1.07-1.93 | 1.39*/.97-1.22 | 1.33*/1/23-1.43 | 1.34*/1.26-1.43 |
| CHD % | 53 | 57* | 40 | 53 | 59* | 1.25*/1.02-1.52 | 1.16+/1.03-1.29 | 1.15*/1.10-1.21 | 1.16*/1.11-1.21 |
| HTFTP % | 27* | 14 | 22* | 16 | 13 | .58/.47-.71 | .44/.38.41 | .40/.40-1.21 | .41/.31-.44 |
| MI %% | 11* | 9 | 10 | 10 | 9 | .94/.68-1.29 | .73/.61-.88 | .62/.57-.68 | .51/.61-.70 |
| AFIB % | 49 | 59* | 37 | 40 | 64* | 1.43*/1.20-1.42 | 1.19*/1.05-1.33 | 1.52*/1.44-1.59 | 1.45*/140-1.54 |
| CKD % | 40* | 38 | 32 | 36 | 39* | .95/.79-1.16 | .89/.79-1.00 | .84/.79-.88 | .85/.81-.89 |
| COPD % | 32* | 24 | 16 | 23 | 25* | .73/.57-.93 | .68/.60-.78 | .66/.63-.70 | .71/.64-.71 |
| Dep % | 19 | 20 | 25* | 25 | 19 | 1.13/.92-1.40 | 1.12/.98-1.27 | 1.02/.97-1.09 | 1.05/.99-1.10 |
| Dement % | 1.3 | 4.6* | 1.3 | 1.8 | 5.4 | 16.3/6.12-43.2 | 4.51*/2.89-6.00 | 1.73*/1.56-1.92 | 1.84*/1.65-2.02 |

***Table 1:*** *Clinical characteristics (%) and Odd ratios and 95% Confidence Interval (CI) of stroke by age in 2010 (n = 9,770).*

*+ &* OR is significant at p < .01 and p < .001 in multivariate logistic regression models; young= 20-50 yrs old ; Mid-age= 51-64 years; Elderly= 65+ years; HTN: Hypertension; DM: Diabetes Mellitus; Chol: Hyperlipidemia; CHD: Coronary Heart Disease; HTFTP: Heart Failure; MI: Myocardial Infarction; AFib: Atrial Fibrillation; CKD: Chronic Kidney Disease; COPD: Chronic Obstructive Pulmonary Disease; Dep: Depression; Dement: Dementia; OR: Odd Ratios; CI: 95% Confidence Interval.*

Stroke prevalence was higher among females than males (4.3% vs. 4.1%, p < .001). Within age groups, stroke prevalence was similar across gender among younger and mid-age patients but higher among the elderly females (F:M; 4.6% vs. 4.4%, p < .01, table 2, cols. 5 - 6). Further, HTN, CHD and AFib were all associated (p < .001) with gender across three age groups (odds ratios; table 2, cols. 1 - 6). Diabetes

emerged as a risk factor only for Elderly females (Table 2, col. 6) along with dementia which related to stroke ($p < .01$) for both males and females in the mid-age and elderly groups. Finally, depression emerged as a risk factor only for the elderly males (Table 2, col. 5).

| Variables | Young Male | Young Female | Mid-age Male | Mid-age Female | Elderly Male | Elderly Female |
|---|---|---|---|---|---|---|
| N → | 331 | 205 | 836 | 553 | 3521 | 4324 |
| Cols -> | 1 | 2 | 3 | 4 | 5 | 6 |
| Stroke % | 3.1 | 2.8 | 3.4 | 3.2 | 4.4 | 4.6* |
| HTN OR | 2.22*/ | 2.41*/ | 2.56*/ | 2.54*/ | 2.05*/ | 2.05*/ |
| CI | 1.46-2.2.78 | 1.65-3.51 | 2.02-3.23 | 1.91-3.46 | 1.84-2.29 | 1.84-2.28 |
| DM OR | 1.09/ | .89/ | 1.08/ | 1.11/ | 1.01/ | 1.10+/ |
| CI | .85-1.37 | .65-1.22 | .92-1.24 | .92-1.34 | .95-1.09 | 1.03-1.17 |
| Chol OR | 1.60*/ | 1.25/ | 1.54*/ | 1.20/ | 1.31*/ | 1.35*/ |
| CI | 1.13-2.67 | .66-2.00 | 1.24-1.89 | .91-1.58 | 1.18-1.46 | 1.22-1.48 |
| CHD OR | 1.30+/ | 1.12/ | 1.08/ | 1.25+/ | 1.18*/ | 1.13*/ |
| CI | 1.01-1.67 | .79-1.57 | .92-1.25 | 1.04-1.50 | 1.09-1.27 | 1.06-1.25 |
| HTFTP OR | .54/ | .64/ | .39/ | .54/ | .38/ | .41/ |
| CI | .42-.71 | .45-92 | .32-.48 | .42-.66 | .,34-.42. | .37-.45 |
| MI OR | .77/ | 1.44/ | .70/ | .77/ | .58/ | .66/ |
| CI | .50-1.12 | .82-2.46 | .56-.89 | .56-1.05 | .51-.65 | .60-.75 |
| AFIB OR | 1.38+/ | 1.58*/ | 1.15+/ | 1.17+/ | 1.32*/ | 1.67*/ |
| CI | 1.07-1.77 | 1.15-2.11 | 1.00-1.33 | 1.02-1.45 | 1.26-1.45 | 1.56-1.78 |
| CKD OR | .96/ | .93/ | .86/ | .91/ | .83/ | .85/ |
| CI | .75-1.22 | .68-1.32 | .74-1.00 | .77-1.13 | .77-.89 | .80-.91 |
| COPD OR | .89/ | .55/ | .64/ | .73/ | .67/ | .66/ |
| CI | .65-1.18 | .36-.83 | .54-.76 | .61-.90 | .62-.73 | .67-.71 |
| Dep OR | 1.15/ | 1.12/ | 1.13/ | 1.13/ | 1.15*/ | .96/ |
| CI | .90-1.55 | .82-1.53 | .95-1.35 | .94-1.36 | 1.05-1.26 | .89-1.03 |
| Dement OR | 16.9/ | 9.61/ | 3.35+/ | 6.00/ | 1.92*/ | 1.60*/ |
| CI | 5.7-50.5 | 9.5-93.4 | 1.75-6.68 | 3.30-10.9 | 1.64-2.25 | 1.39-1.83 |

***Table 2:*** *Odd ratios (OR) and 95% Confidence Interval (CI) of CVD Factors By age and gender.*

*+ and * indicate OR significant at $p < .01$ and $p < .001$ respectively; young age = 20 -50 years old; Mid-age = 51 - 64 years; Elderly= 65+yrs; HTN: Hypertension; DM: Diabetes Mellitus; Chol: Hyperlipidemia; CHD: Coronary Heart Disease; HTFTP: Heart Failure; MI: Myocardial Infarction; AFib: Atrial Fibrillation; CKD: Chronic Kidney Disease; COPD: Chronic Obstructive Pulmonary Disease; Dep: Depression; Dement: Dementia;*

## Stroke hospital cost by age and gender

Table 3 shows that the average stroke cost for 1st stroke was $80,696, and it was higher among young stroke patients compared to middle age and elderly patients (Y:M: E; $127,370 vs. $102,190 vs. $73,877, $p < .05$). The total cost in 2010 was 8.4% higher for stroke patients compared to non-stroke patients (Table 3, $142,020 vs. $135,200, $p < .001$). Further, more than 50% of the total costs were from the cost of 1st stroke admission. The higher total cost of Younger compared to Mid-age or Elderly patients (Y:M: E; $214,240 vs. $177, 200 vs. $130,860) was due to longer hospitalization (22 days vs. 17 among mid-age vs. 16 among the elderly).

Table 4 shows cost breakdown by age and gender. Here, both the cost for stroke alone and total cost for the entire year were higher for males than females (M:F; stroke alone; $$88,057 vs. $73,861, $p < .01$, total cost; $151,380 vs. $133,390, $p < .01$, cols. 4 - 5). Moreover, when gender and age were examined separately, the costs were higher ($p < .001$) for younger males than mid-age or elderly males (Y:M: E; stroke cost alone $147,700 vs. $105,220 vs. $78,492; total cost $259,870 vs. $168,770 vs. $137,060 cols. 1 - 3). Among females, the cost for stroke alone and total cost were higher ($p < .01$) for Mid-age females compared to Younger or Elder females (M: Y:E; stroke cost alone: $96,926 vs. $95,470 vs. $70,165; total cost: $189,930 vs. $140,570, vs. $125,820, see cols. 6 - 8). Overall, stroke cost among the elderly was lower for both males and females compared to same gender patients in other groups.

| Variables | No Stroke | All Stroke | Young 20-50 | Mid-age 51-64 | Elderly 65+ |
|---|---|---|---|---|---|
| N→ | 224,695 | 9770 | 536 | 1389 | 7845 |
| Age | 74 | 76 | 44 | 58 | 81 |
| Comorb. | 3.7 | 3.8 | 3.2 | 3.6 | 3.8* |
| Charlson | 3.5 | 3.8 | 3.5 | 4.0 | 3.9 |
| # Adm | 1.6 | 2.0* | 2.7* | 2.1 | 1.9 |
| LOS | 12.4 | 16.4* | 21.8 | 17.0 | 15.7 |
| 1st Stroke Cost $ | ------- | 80,696 | 127,370 | 102,190 | 73,877 |
| Total cost $ SD | 135,200 25,353 | 142,020* 24,403 | 214,240* 31,524 | 177,200 28,162 | 130,860 22,946 |

***Table 3:*** *Average hospital cost of stroke by age, 2010.*

*+ & * stand for significant differences between two columns at p < .05, and p < .001 respectively; comorb: Number of Comorbidities; Charlson: Charlson Index of Comorbid Severity; # Adm: Number of Hospital Admissions; LOS: Length of Stay (Days); Stroke cost $: Stroke Cost for 1st Discharge; Total cost $: Total Cost in 2010 of all hospital admissions; SD: Standard Deviation of Total Cost.*

| Variables | Young Male | Mid-age Male | Elderly Male | Total Male | Total Female | Young Female | Mid-Age Female | Elderly Females |
|---|---|---|---|---|---|---|---|---|
| Col → | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| N → | 331 | 836 | 3521 | 4688 | 5082 | 205 | 553 | 4324 |
| Age | 44 | 58 | 80 | 73 | 78 | 43 | 58 | 83 |
| Comorb. | 3.4 | 3.6 | 3.9* | 3.8* | 3.6 | 2.9 | 3.7* | 3.7 |
| Charlson | 3.5 | 3.8 | 4.1* | 4.0+ | 3.8 | 3.5 | 4.3+ | 3.7 |
| # Adm | 2.8* | 2.0 | 1.9 | 2.0 | 2.0 | 2.4 | 2.3 | 1.9 |
| LOS | 26.5* | 16.3 | 14.9 | 16.0 | 16.8 | 14.5 | 18.3 | 16.7 |
| 1st Stroke Cost $ | 147,700 | 105,220 | 78,492` | 88,057 | 73,861 | 95,470 | 96,926 | 70,165 |
| Total cost$ | 259,870* | 168,770 | 137,060 | 151,380 | 133,390 | 140,570 | 189,930 | 125,820 |
| SD | 32,229 | 25,981 | 26,836 | 27,732 | 20,831 | 16,609 | 31,152 | 19,194 |

***Table 4:*** *Average hospital cost of stroke by age and gender, 2010.*

*+ & * stand for significant differences between two columns at p < .05, and p < .001 respectively; comorb: Number of Comorbidities; Charlson: Charlson Index of Comorbid Severity; # Adm: Number of Hospital Admissions; LOS: Length of Stay (Days); Stroke cost $: Stroke Cost for 1st Discharge; Total cost $: Total Cost in 2010 of all hospital admissions; SD: Standard Deviation of Total Cost.*

## Discussion

Our findings are highly relevant with regard to younger males and older females. First, our findings are consistent with the hypothesis that ischemic stroke prevalence increases with increasing age among hospitalized patients. Second, the gender related disparity that appeared for ischemic stroke in the elderly group also appears to be age-related. The higher stroke prevalence among hospitalized, post-menopausal, elderly females may be due to loss of various protective factors (e.g. estrogen) that existed in younger years [34,35].

Younger hospitalized adults had a lower prevalence of stroke but longer hospital stay and higher costs. It is possible to offer various hypotheses about why this may be so. For example, while the younger patients shared similar risk factors (HTN, CHD, hyperlipidemia, atrial fibrillation) with other age groups, these risk factors (due to lack of health insurance) may be poorly controlled in the younger group, and as a consequence, younger patients may have had more severe stroke involving brain swelling which requires surgical interventions [36] (such as de-compressive hemicraniectomy). Surgery usually prolongs hospitalization and adds to costs. Further, In the absence of a health insurance, longer hospitalization may also occur because such patients cannot be transferred easily to a Rehabilitation Center. All these factors could have contributed to longer stay and higher costs among the younger patients. Analytic epidemiologic research (designed a

priori) would be required to test these hypotheses. Finally, our finding that AFib was a significant risk factor in the younger group was surprising as AFib is usually more frequent at older ages. It is tempting to speculate that the occurrence of Afib in our younger group may be related to uncaptured variables such as drug abuse or abuse of recreational substance that may adversely affect cardiac rhythm at younger ages.

The overall cost of treating stroke for a year has reportedly varied from $20,396 to $77,864 [3,37-39]. The stroke cost in our study ($80,696) appears to be consistent with these reports. Our cost estimates also varied notably by age and gender. For example, the higher cost occurring among the males appear to be consistent with the hypothesis that males (compared to females) delay seeking professional help until late in the progression of their illness [40-44] possibly resulting in more complex and costly treatment. However, in our data, the mid-age females had higher costs compared to females in other groups. The higher cost of mid-age female may have occurred due to higher prevalence of depression among them (33% in mid-age vs. 29% among young vs. 21% among elderly, $p < .05$). The role of depression in stroke cost warrants further examination as previous research has reported that co-morbid depression increases healthcare costs of heart failure, stroke, breast and lung cancers [3,45-48].

## Limitations

Generalization of these results are limited due to several factors. First, California Hospital Discharge Data (HDDS) do not include patients from Veterans Affairs hospitals (VA) or patients hospitalized in mental institutions. Additionally, these data do not provide information about reimbursed costs or patient characteristics such as marital status, educational attainment, or annual income. Clinical data such as medications, clinical tests performed or clinical test results are not included in HDDS data. Patients are also assigned different identification numbers each year (for reasons of confidentiality) which prevents follow-ups. In part, these factors limit generalizability to those included in this discharge data set. Also, since the present findings are confined to hospitalizations and do not include information about pre-hospitalization, mortality and/or morbidity, they cannot specifically quantify risk itself. Despite these and other limitations, these results are highly useful for policy and programmatic purposes as they represent a large sample from a racially and ethnically diverse population of California.

## Conclusion

We conclude that stroke prevalence among hospitalized patients in these data increases with age and is highest among elderly women, possibly because of loss of protective pre-menopausal mechanisms. Tests of these and other hypotheses generated by these descriptive data would require analytic epidemiologic designed studies. Confirmation of the present results would call for randomized controlled trials to determine whether evidence-based programs for early risk factor prevention and/or treatment can reduce stroke morbidity and healthcare costs.

## Bibliography

1. Centers for Disease Control and Prevention. Stroke (2012).

2. National Institute of Neurological Disorders and Stroke. Stroke: Hope through research (2012).

3. Husaini BA., *et al*. "Depression increases stroke hospitalization cost: an analysis of 17,010 stroke patients in 2008 by race and gender". *Stroke Research and Treatment* (2013): 846732.

4. Kissela B., *et al*. "Stroke in a biracial population: the excess burden of stroke among blacks". *Stroke* 35.2 (2004): 426-431.

5. Hubert HB., *et al*. "Obesity as an independent risk factor for cardiovascular disease: a 26-year follow-up of participants in the Framingham Heart Study". *Circulation* 67.5 (1983): 968-977.

6. Gill JS., *et al*. "Stroke and alcohol consumption". *New England Journal of Medicine* 315.17 (1986): 1041-1046.

7. Yao X., *et al*. "Age- and Gender-Specific Prevalence of Risk Factors in Patients with First-Ever Ischemic Stroke in China". *Stroke Research and Treatment* (2012): 136398.

8. Andersen KK., *et al*. "Age- and gender-specific prevalence of cardiovascular risk factors in 40 102 patients with first-ever ischemic stroke: a Nationwide Danish Study". *Stroke* 41.12 (2010): 2768-2774.

9. Fang MC., *et al*. "Gender differences in the risk of ischemic stroke and peripheral embolism in atrial fibrillation: The anticoagulation and risk factors in atrial fibrillation (ATRIA) study". *Circulation* 112.12 (2005): 1687-1691.

10. Giralt D., *et al*. "The gender gap in stroke: a meta- analysis". *Acta Neurologica Scandinavica* 125.2 (2012): 83-90.

11. Roquer J., *et al*. "Sex differences in first-ever acute stroke". *Stroke* 34.7 (2003): 1581-1585.

12. Samajlovic D. "Strokes in young adults: epidemiology and prevention". *Vascular Health and Risk Management* 11 (2015): 157-164.

13. Ellis C. "Stroke in young adults". *Disability and Health Journal* 3.3 (2010): 222-224.

14. Schneider S., *et al*. "Risk Factors and Etiology of Young Ischemic Stroke Patients in Estonia". *Stroke Research and Treatment* (2017): 8075697.

15. Jacobs BS., *et al*. "Stroke in the young in the Northern Manhattan Stroke Study". *Stroke* 33.12 (2002): 2789-2793.

16. Putaala J., *et al*. "Analysis of 1008 consecutive patients aged 15 to 49 with first-ever ischemic stroke: the Helsinki Young Stroke registry". *Stroke* 40.4 (2009): 1195-1203.

17. Putaala J., *et al*. "Statins after ischemic stroke of undetermined etiology in young adults". *Neurology* 77.5 (2011): 426-430.

18. Putaala J., *et al*. "Diabetes mellitus and ischemic stroke in the young: clinical features and longterm prognosis". *Neurology* 76.21 (2011): 1831-1837.

19. Wu TY., *et al*. "Young ischaemic stroke in South Auckland: a hospital-based study". *New Zealand Medical Journal* 125.1364 (2012): 47-56.

20. Mackey J. "Evaluation and management of stroke in young adults". *Continuum (Minneap Minn)* 20.2 (2014): 352-369.

21. Marini C., *et al*. "Incidence of stroke in young adults: a review". *Stroke Research and Treatment* (2011): 535672.

22. Sulena S and Sharma AK. "Drug Abuse as an Emanating Risk for Stroke in Young Adults". *The Journal of the Association of Physicians of India* 65.12 (2017): 74-78.

23. Maaijwee NA., *et al*. "Ischaemic stroke in young adults: risk factors and long-term consequences". *Nature Reviews Neurology* 10.6 (2014): 315-325.

24. Shaper AG., *et al*. "Risk factors for stroke in middle age British men". *British Medical Journal* 302.6785 (1991): 1111-1115.

25. Shaper AG., *et al*. "British Regional Heart Study: cardiovascular risk factors in middle-aged men in 24 towns". *British Medical Journal (Clinical Research Ed.)* 283.6285 (1981): 179-186.

26. Murakami K., *et al*. "Risk Factors for Stroke among Young-Old and Old-Old Community-Dwelling Adults in Japan: The Ohasama Study". *Journal of Atherosclerosis and Thrombosis* 24.3 (2017): 290-300.

27. Shuaib A and Hachinski VC. "Mechanisms and management of stroke in the elderly". *Canadian Medical Association Journal* 145.5 (1991): 433-443.

28. Arboix A., *et al*. "Cardiovascular risk factors in patients aged 85 or older with ischemic stroke". *Clinical Neurology and Neurosurgery* 108.7 (2006): 638-643.

29. Auriel E., *et al*. "Characteristics of first ever ischemic stroke in the very elderly: profile of vascular risk factors and clinical outcome". *Clinical Neurology and Neurosurgery* 113.8 (2011): 654-657.

30. Chen Y., *et al*. "Comparison of the Risk Factor Profile, Stroke Subtypes, and Outcomes Between Stroke Patients Aged 65 Years or Younger and Elderly Stroke Patients: A Hospital-based Study". *International Journal of Gerontology* 7.4 (2013): 205-208.

31. Ivan CS., *et al*. "Dementia After Stroke. The Framingham Study". *Stroke* 35.6 (2004): 1264-1268.

32. Cojocaru GR., *et al*. "Post-stroke depression and the aging brain". *Journal of Molecular Psychiatry* 1.1 (2013): 14.

33. Charlson ME., *et al*. "A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation". *Journal of Chronic Diseases* 40.5 (1987): 373-383.

34. de Lecinana MA., *et al*. "Risk of ischemic stroke and lifetime estrogen exposure". *Neurology* 68.1 (2007): 33-38.

35. Yaffee K., *et al*. "Age During Estrogen Therapy May Impact Later Dementia". *Annals of Neurology* (2011).

36. Wijdicks EF., *et al*. "Middle Cerebral Artery Territory Infarction and Early Brain Swelling: Progression and Effect of Age on Outcome". *Mayo Clinic Proceedings* 73.9 (1998): 829-836.

37. Wang G., *et al*. "Costs of Hospitalization for Stroke Patients Aged 18-64 Years in the United States". *Journal of Stroke and Cerebrovascular Diseases* 23.5 (2014): 861-868.

38. Demaerschalk BM., *et al*. "US Cost Burden of Ischemic Stroke: A Systematic Literature Review". *American Journal of Managed Care* 16.7 (2010): 525-533.

39. Yacoub HA., *et al*. "Trends in Outcome and Hospitalization Cost among Adult Patients with Acute Ischemic Stroke in the United States". *Journal of Vascular and Interventional Neurology* 8.2 (2015): 19-23.

40. Husaini BA., *et al*. "Psychiatric symptoms and help-seeing behavior among the elderly: An analysis of racial and gender differences". *Journal of Gerontological Social Work* 21.3 (1994): 177-193.

41. Corney RH and Courtenay WH. "Behavioral factors associated with disease, injury and death among men: Evidence and implications for prevention". *The Journal of Men's Studies* 9.1 (1990): 81-142.

42. Dolan A. "You Can't ask for a Dubonnet and lemonade!': working class masculinity and men's health practices". *Sociology of Health and Illness* 33.4 (2011): 586-601.

43. Galdas PM., *et al*. "Men and health help-seeking behavior: literature review". *Journal of Nursing* 49.6 (2005): 616-623.

44. Greenlund KJ., *et al*. "Low public recognition of major stroke symptoms". *American Journal of Preventive Medicine* 25.4 (2003): 315-319.

45. Grahaam MM., *et al*. "Sex differences in patients seeking medical attention for prodromal symptoms before an acute coronary event". *American Heart Journal* 156.6 (2008): 1210-1216.

46. Husaini BA., *et al*. "Smoking, depression, and hospital costs of respiratory cancers: Examining race and sex variation". *Family Medicine and Community Health* 5.1 (2017): 29-42.

47. Husaini BA., *et al*. "Depression Effects on Hospital Cost of Heart Failure Patients in California: An Analysis by Ethnicity and Gender". *Indian Journal of Community Medicine* 43.1 (2018): 49-52.

48. Husaini BA., *et al*. "Examining Effects of Depression on Hospital Cost of Breast Cancer among Women". *EC Neurology* 10.7 (2018): 513-521.

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