Smoking and Stroke: A Case–Control Study

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INTRODUCTION

A stroke is a non-communicable disease of increasing importance. According to the World Health Organization (WHO), 15 million people worldwide suffer from a stroke every year. Globally, 6.5 million stroke deaths occurred in 2013, making stroke the second most common cause of death following ischemic heart disease. Objectives: The objective of the study was to study smoking as a risk factor in acute cerebrovascular stroke patients. Methods: The current research was carried out in a tertiary care hospital of central Gujarat. One hundred forty-eight freshly diagnosed cases of CT scan/MRI-confirmed stroke and 148 non-stroke tests were studied with written permission. The data were analyzed using the software EPI INFO TM 7.0.8.0, the Chi-square test, and the ratio of odds. Results: Of the total 148 cases, 100 (67.56%) were male and 48 (32.43%) were female. Smokers are significantly higher among the cases compared to controls. A significant association between smoker and stroke was observed. Conclusion: The results of the research show a strong link between smoking cigarettes and the risk of ischemic stroke in both males and women, which reinforces the need for aggressive smoking cessation in young adults.

Key words: Cerebrovascular accident, Smoking, Stroke
factors. Non-modifiable risk variables include age, gender, and family genetics.

Few studies have been conducted in advanced nations, but very few studies have been conducted in developing nations such as India. These studies recognized that smoking is one of the independent risk factors that are extensively associated with stroke. Tobacco smoke contains over 7000 toxic chemicals, including carbon monoxide, formaldehyde, arsenic, and cyanide. These compounds are transported from your lungs to your bloodstream, altering and destroying the cells in the body. The changes that these chemicals cause can increase your risk of stroke.[3]

**METHODOLOGY**

The current research was performed in the medicine and MICU departments from January 2018 to June 2018 in one of the tertiary care hospital of central Gujarat (Sir Sayaji General Hospital, Vadodara).

Assuming the power ratio of the number of controls the same as numbers of cases specifying values for two-sided confidence level 95% and odd ratio 2.15 which was the minimum risk factor in the previous study (obesity, odds ratio = 2.15)[4] was taken to calculate the sample size. Hence, considering 82% of cases with exposure and 68% of controls with exposure, the total sample size was 296 including 148 cases and 148 controls have been selected.

Cases were those whose diagnosis of a stroke had been confirmed by CT scan/MRI. One hundred forty-eight such cases were included in the study. The recruits of cases in the study were incident cases (first ever in the lifetime) within 72 hours after admission in SSGH. If the patient was unable to communicate sufficiently to complete the study questionnaire, proxy respondent was used. The valid proxy respondent was a spouse (husband/wife) or 1st-degree relative (a person’s parent, sibling, relative, or more than 18-year-old son/daughter) who was living in the same home or was aware of the patient’s previous medical history and present treatments.

Patients who were admitted to the same ward for circumstances other than stroke were chosen for the incorporation of control. One control was chosen for each stroke case. One hundred forty-eight controls were chosen in the same way (any person admitted to the department of medicine/ward of SSGH without a stroke such as typhoid, hepatitis [jaundice], diarrhea, COPD, and malaria). For exclusion of cases and controls, the patient not ready to participate in the research and patients with the transient ischemic attack, poisoning, trauma-related symptoms, and history of IHD.

**RESULTS**

The present study was conducted among 148 cases of stroke and 148 controls in one of the tertiary care hospital of central Gujarat. After data analysis, we found that out of the total confirmed cases, 67.56% were males and 32.43% were females.

As shown in Table 1, 83 (56%) of the cases and 36 (24%) of the controls were smokers. The crude odds ratio was 3.97 that are odds of getting stroke among smokers were almost four times more as compared to non-smokers.

In the present study, gender-specific odds ratio was calculated. This was 5.63 (OR1) (CI = 3.05 to 10.51, P < 0.0001) in males and 17.53 (OR2) (CI = 0.97 to 316.25, P < 0.0001) in females. Since all the three odds ratios were different, it can be concluded that gender is an effect modifier when looking into the association of smoking and occurrence of stroke (CI = 2.42 to 6.53, P < 0.0001).

As per Table 2, 79 (95%) of the cases and 33 (92%) of the controls smoked on a daily basis. The crude odds ratio was 1.80, that is, odds (chance) of getting stroke among daily smokers were almost two times more as compared to occasional smokers.

Almost half of the cases, 44 (50.70%) smoked >10 times/day and 18 (54.55%) controls smoked 1 to 5 times/day. As illustrated in Figure 1, χ2 (trend) = 25.56, P < 0.0001 shows a statistically significant association between the frequency of smoking and stroke.

Table 3 shows 66 (80%) of the cases and 22 (61%) of the controls smoked bidis. The crude odds ratio was 2.47, that is, odds (chance) of getting stroke among bidi smokers were almost 2 times more as compared to cigarette smokers.

Figure 2 shows the distribution of smokers according to the duration of smoking among cases of stroke and controls.

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**Table 1: Distribution of study subject according to the history of smoking**

<table>
<thead>
<tr>
<th>Smoker</th>
<th>Cases</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male (n=100)</td>
<td>Female (n=48)</td>
</tr>
<tr>
<td>Yes</td>
<td>76 (91.57%)</td>
<td>7 (8.43%)</td>
</tr>
<tr>
<td>No</td>
<td>24 (36.92%)</td>
<td>41 (63.08%)</td>
</tr>
</tbody>
</table>

OR=3.97, 95% CI=2.42 to 6.53, P < 0.0001
Of 97 cases who smoked, 47 (56.63%) cases were having a duration of a smoking >15 years and in controls of 51 who smoked 15 (41.67%) were having a duration of smoking <5 years. This association was statistically significant ($\chi^2$ (trend) = 16.55, $P < 0.0001$), as shown in Figure 2.

**DISCUSSION**

The present study was conducted in the medicine wards and MICU from January 2018 to June 2018 of SSG Hospital Vadodara, one of the tertiary care hospital of central Gujarat.

When evaluating this study, we found that odds of getting stroke among smokers were nearly four times higher compared to non-smokers, and gender is an effect modifier. Compared to occasional smokers, the odds of having stroke among daily smokers were almost twice that. The analysis also indicates a statistically significant correlation between smoking and stroke rates (higher frequency and longer duration of exposure to smoking raise stroke chances). Chances of stroke are more in female smokers than in male smokers.

Similar results found in two different studies Shah RS et al. (2010) and Meschia JF et al. (2014), current smokers have a two to four times higher risk of stroke than non-smokers or those who have stopped for more than 10 years. Smoking cigarettes are a risk factor in ischemic strokes and SAH.[9,10]

A comparable result found in a study done by Bhat et al. (2008) showed multivariate adjustment, the OR comparing current smokers to never smokers was 2.6 ($P < 0.0001$) without any distinction in stroke hazard between former smokers and never smokers. Adjusted OR increased with a rise in the number of cigarettes smoked/day (OR=2.2 for 1–10 cigs/d; 2.5 for 11–20 cigs/d; 4.3 for 21–39 cigs/d; 9.1 for 40 or more cigs/d).[11]

Research by Peters et al. (2013) showed that 81 prospective cohort studies involving 39,80,359 individuals and 42,401 strokes were available. Smoking has been an independent risk factor for both sexes of stroke. The general risk of female smoking-related stroke relative to male (RRR, 1.06 [95% confidence interval, 0.99–0.13]) was recorded in the pooled, multi-addressed RRR. Regional proof has shown that females are more dangerous than males in western countries, but not in Asian cultures (RR, 1.10 [1.02–1.18]) and (RRR,0.97 [0.87–1.09]).[12]

Systematic review and meta-analysis by Pan, Jin, et al. included 14 studies involving 303134 subjects. According to the meta-analysis, smokers had an overall increased risk of stroke compared to non-smokers, with a pooled odds ratio (OR) of 1.61 (95% CI: 1.34–1.93, $P < 0.023$). A subgroup analysis conducted based on smoking status revealed ORs of 1.92 (95% CI: 1.49–2.48) for current smokers and 1.30 (95% CI: 0.93–1.81) for former smokers. In addition, the relationship between the stroke of any type and smoking status was also statistically significant; current smokers had an increased risk of stroke compared to non-smokers (OR: 1.46, 95% CI: 1.04–2.07, $P < 0.023$).[13]

Kurth et al. published two papers in 2003 detailing the danger of hemorrhagic stroke in male and female smokers.[14,15] These studies showed an increased risk of total hemorrhagic stroke, ICH, and SAH in females smoking 15 or more cigarettes.
per day (RR: 3.29 [95% CI: 1.72–6.29], 2.67 [95% CI: 1.04–6.90], and 4.02 [95% CI: 1.63–9.89], respectively) and males smoking 20 or more cigarettes/day (RR: 2.36 [95% CI: 1.38–4.02], 2.06 [95% CI: 1.08–3.96] and 3.22 [95% CI: 1.26–8.18], respectively). Ischemic stroke is not the only type of smoking-related stroke; the risk of both intracerebral hemorrhage (ICH) and subarachnoid hemorrhage (SAH) is also high. Data from the Neaton et al. research showed a strong association between smoking and SAH, ICH, and non-hemorrhagic stroke.[16]

Similar results found in a study conducted by Juvela et al. found that the increased risk of SAH is apparently related to the increased incidence of aneurysms seen in smokers. Heavy smoking (>20 cigarettes/day) men and actively smoking women were found to have modified RRs of 7.3 (95% CI: 3.8–14.3) and 2.1 (95% CI: 1.2–3.6) aneurysmal hemorrhage, respectively, compared to men who had never smoked and women who were not current smoker.[17]

A number of researchers have used the use of pack-years to measure lifetime exposure to cigarettes. This includes both the number of cigarettes smoked per day and the duration of smoking (where a pack is defined as 20 cigarettes/day and this is multiplied by the number of years to calculate pack-years). Love et al. have recorded a 4% increase in the risk of cerebral infarction per cigarette year smoked. Gorelick et al. found that individuals who had been smoking for 1–33 pack-years had an odds ratio (OR) for cerebral infarction of 2.48 (95% CI: 1.43–4.29) in support of these results. This increased to OR 5.60 (95% CI, 3.17–9.88) for this who smokes more than 33 pack-years. This gives evidence of an increased risk of stroke with increased smoking pack-years.[18,19]

CONCLUSION

1. The study shows that smokers are more likely to develop stroke and that the chances of stroke are higher for female smokers compared to male smokers.
2. Higher frequency and longer duration of exposure to smoking increase the chance of stroke.

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