Cognitive impairment after intracerebral hemorrhage: a systematic review and meta-analysis Syed Faraz Kazim, MD, PhD, Jonathan V. Ogulnick BS, Myranda B. Robinson BS, Javed Khader Eliyas MD, Benjamin Q. Spangler BS, Tyler J. Hough BS, Erick Martinez BS, Zafar Karimov BS, Devan W. Vidrine MA, Meic H. Schmidt MD, MBA,

INTRODUCTION

- Spontaneous, non-traumatic intracerebral hemorrhage (ICH) refers to bleeding within the brain parenchyma that occurs in the absence of trauma and carries significant morbidity and mortality
- ICH accounts for 6.5-19.6% of all The strokes, but it carries the highest mortality rate (1-year survival ~ 40% and 10-year survival ~ 24%) of all stroke subtypes
- strong association has been While a identified between stroke and dementia, most of the available literature focuses on post-stroke dementia in patient cohorts with ischemic stroke, and there are very few cognitive studies evaluating clinical dysfunction after ICH.

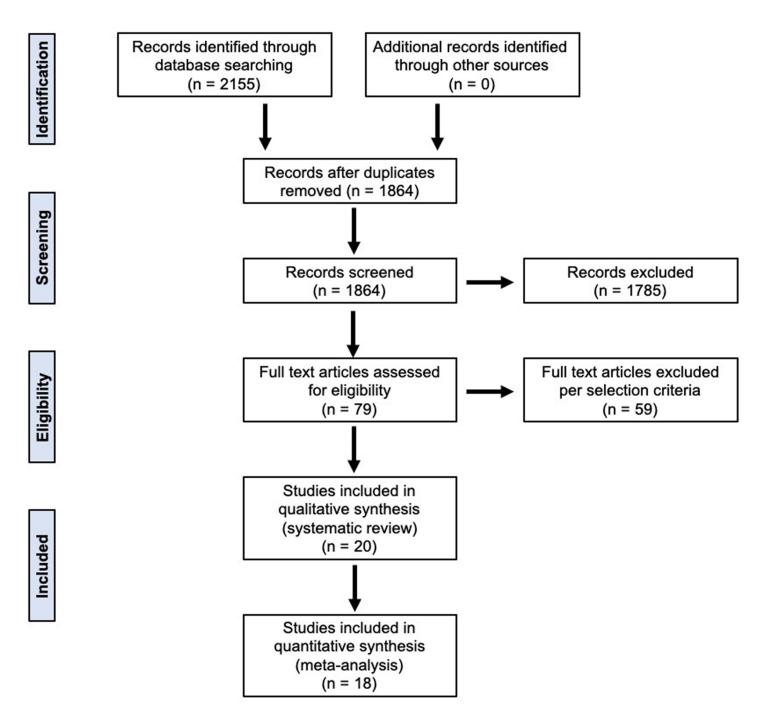
OBJECTIVES

The aim of the present systematic review and meta-analysis was to analyze the available clinical literature with regards the prevalence prognostic predictors of post-ICH and cognitive impairment. We conducted a pooled analysis of available studies to estimate the prevalence of post ICH cognitive impairment

MATERIALS AND METHODS

- The present systematic review and meta-analysis was performed following the PRISMA guidelines
- We conducted literature search until July 31, 2020 from following databases: PubMed, ScienceDirect, Scopus, and Web of Science
- The quality of the included studies was assessed by using the STROBE statement checklist
- The metaphor R package for R statistical software version 3.5.3 and MedCalc Statistical Software version **19.2.3 were used to perform the meta-analysis**

1. Flow diagram of literature selection process per **PRISMA** guidelines in the present systematic review and meta-analysis



3. Forest plot of pooled prevalence of post-ICH cognitive impairment in acute to subacute group (studies with follow-up duration ≤ 6 months)

| Study | Cognitive deficit/Total | Pre | |
|-----------------------|----------------------------|-----|--|
| Aam et al., 2020 | 35/53 | | |
| Gong et al., 2020 | 106/141 | | |
| Gong et al., 2020 | 57/90 | | |
| Banerjee et al., 2018 | 158/187 | | |
| Planton et al, 2017 | 35/40 | 8 | |
| You et al., 2017 | 75/231 | 3 | |
| Biffi et al., 2016 | 140/738 | | |
| Douiri et al., 2013 | 68/169 | | |
| Nakase et al., 2013 | 49/256 | | |
| Su et al., 2007 | 21/30 | | |
| Nys et al., 2007 | 14/17 | | |
| Tang et al., 2004 | 4/22 | | |
| Total | 1974 | | |
| | Random Heteroge | | |

SUMMARY & CONCLUSIONS

- a follow-up duration ranging from 8 days to 4 years.
- follow-up post-ICH.

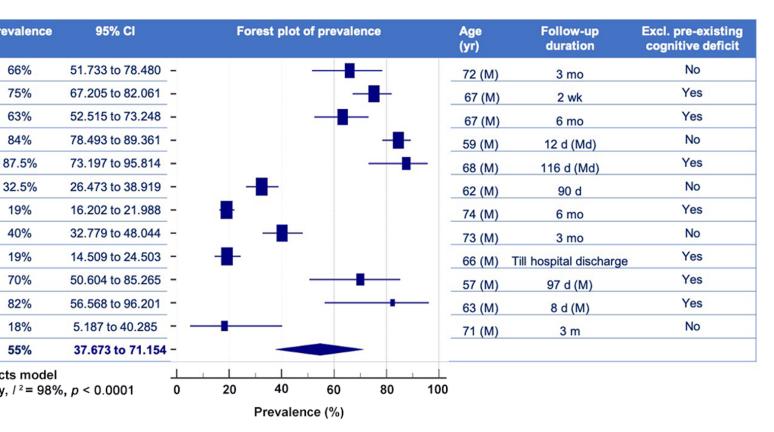
Christian A. Bowers, MD^{*}

Department of Neurosurgery, University of New Mexico Hospital, Albuquerque, NM, USA *Correspondence: CABowers@salud.unm.edu

RESULTS

2. Forest plot of pooled prevalence of post-ICH cognitive impairment in all studies included in the meta-analysis

| Study | Cognitive deficit/Total | Prevalence | 95% CI | Forest plot of prevalence | Age (yr) | Follow-up duration | Excl. pre-existing cognitive deficit |
|-------------------------|----------------------------|------------------------------------|-----------------------|---------------------------|--------------|------------------------|---|
| Aam et al., 2020 | 35/53 | 66% | 51.733 to 78.480 | | 72 (M) | 3 mo | No |
| Aam et al., 2020 | 24/45 | 53% | 37.872 to 68.340 | | 72 (M) | 18 mo | No |
| Gong et al., 2020 | 106/141 | 75% | 67.205 to 82.061 | | 67 (M) | 2 wk | Yes |
| Gong et al., 2020 | 57/90 | 63% | 52.515 to 73.248 | | 67 (M) | 6 mo | Yes |
| Banerjee et al., 2018 | 158/187 | 84% | 78.493 to 89.361 | | 59 (M) | 12 d (Md) | No |
| Planton et al, 2017 | 35/40 | 87.5% | 73.197 to 95.814 | | 68 (M) | 116 d (Md) | Yes |
| You et al., 2017 | 75/231 | 32.5% | 26.473 to 38.919 | | 62 (M) | 90 d | No |
| Biffi et al., 2016 | 140/738 | 19% | 16.202 to 21.988 | ■ [−] | 74 (M) | 6 mo | Yes |
| Biffi et al., 2016 | 139/435 | 32% | 27.593 to 36.563 _ | − + | 74 (M) | 47.4 mo (M) | Yes |
| Moulin et al., 2016 | 63/218 | 29% | 22.977 to 35.405 - | - F - | 65 (Md) | 4 yr | Yes |
| Moulin et al., 2016 | 31/218 | 14% | 9.481 to 19.059 | . | 65 (Md) | 1 yr | Yes |
| Benedictus et al., 2015 | 62/167 | 37% | 30.361 to 45.698 - | - <u>-</u> | 64 (Md) | 4 yr (Md) | Yes |
| Tveiten et al., 2014 | 27/50 | 54% | 39.324 to 68.185 - | | 71 (M) | 3.8 yr (Md) | No |
| Garcia et al., 2013 | 18/78 | 23% | 14.287 to 33.997 - | | 62 (M) | 40 mo (M) | No |
| Douiri et al., 2013 | 68/169 | 40% | 32.779 to 48.044 - | | 73 (M) | 3 mo | No |
| Nakase et al., 2013 | 49/256 | 19% | 14.509 to 24.503 - | + T | The Mensel - | ill hospital discharge | Yes |
| nle-Hansen et al., 2011 | 7/16 | 44% | 19.753 to 70.122 - | | 72 (M) | 1 yr | Yes |
| Su et al., 2007 | 21/30 | 70% | 50.604 to 85.265 - | | 57 (M) | 97 d (M) | Yes |
| Nys et al., 2007 | 14/17 | 82% | 56.568 to 96.201 - | | 63 (M) | 8 d (M) | Yes |
| de Koning et al., 2005 | 8/19 | 42% | 20.252 to 66.500 - | | 70 (M) | 3-9 mo | No |
| Greenberg et al., 2004 | 19/53 | 36% | 23.143 to 50.197 - | | 55 (M) | 28 mo (M) | Yes |
| Tang et al., 2004 | 4/22 | 18% | 5.187 to 40.285 - | | 71 (M) | 3 m | No |
| Total | 3270 | 46% | 35.948 to 55.943 - | | | | |
| | | effects model neity, / ² = 96.8 | 3%, <i>p</i> < 0.0001 | 20 40 60 80 1 | 00 | | |



6 months)

| Study | Cognitive deficit/Total | Prevalence | 95% CI | Forest plot of prevalence | Age (yr) | Follow-up duration | Excl. pre-existing cognitive deficit |
|--------------------------|----------------------------|-----------------------------------|------------------------|---------------------------|-------------|-----------------------|---|
| Aam et al., 2020 | 24/45 | 53% | 37.872 to 68.340 - | | 72 (M) | 18 mo | No |
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| Greenberg et al., 2004 | 19/53 | 36% | 23.143 to 50.197 - | | 55 (M) | 28 mo (M) | Yes |
| Total | 1296 | 35% | 26.978 to 42.715 - | | | | |
| | | effects model neity, / ²= 86.7 | %, <i>p</i> < 0.0001 0 | 10 20 30 40 50 60 70 | 80 | | |
| | | | | Prevalence (%) | | | |

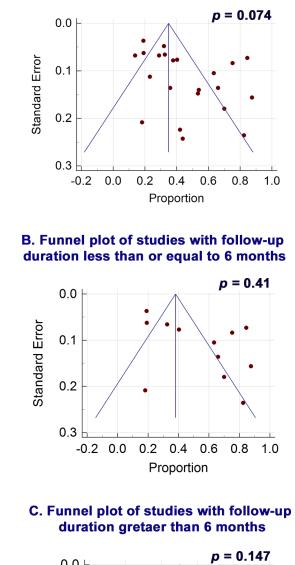
The prevalence of post-ICH cognitive impairment is high. Based on analysis of data from 18 studies (3270 patients), we found prevalence of post-ICH cognitive impairment to be 46% (CI, 35.9-55.9) with

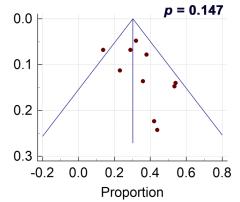
The estimated pooled prevalence of cognitive decline decreased over longitudinal follow-up, from 55% (range 37.7-71.15%) within 6 months of ICH to 35% (range 27-42.7%) with > 6 months to 4 years



5. Funnel plots demonstrating the absence of publication bias

A. Funnel plot of all studies





4. Forest plot of pooled prevalence of post-ICH cognitive impairment in long-term follow-up group (studies with follow-up duration greater than