# Illness Severity and Cerebral Edema in Post-Cardiac Arrest Patients

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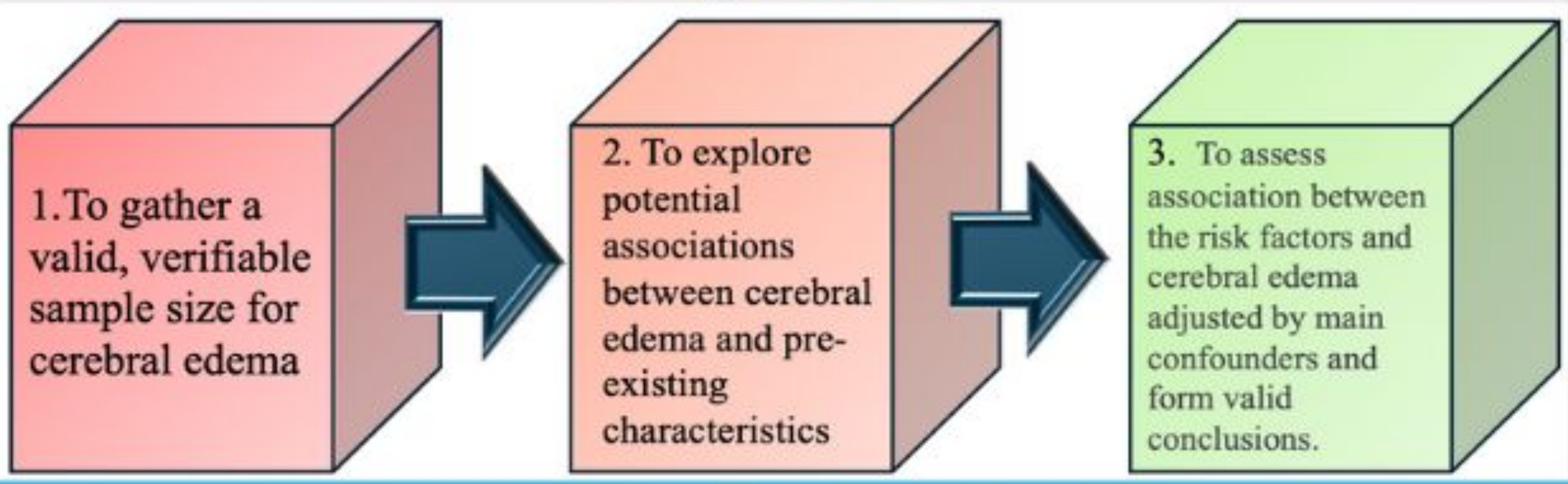
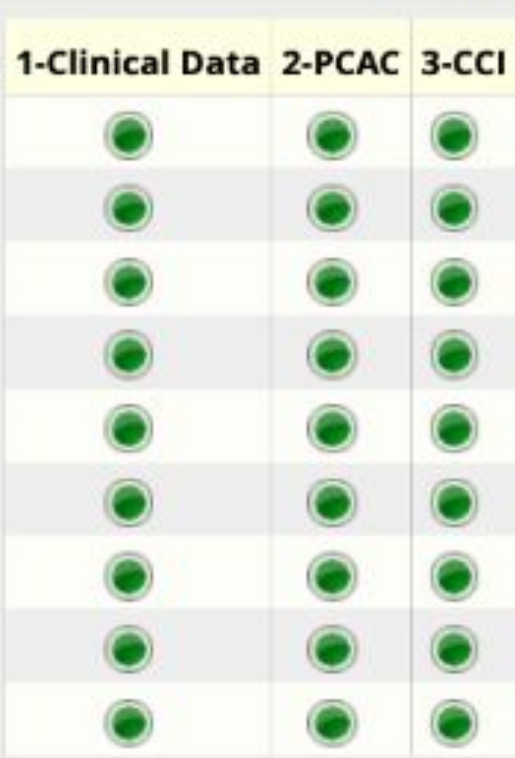
## Introduction

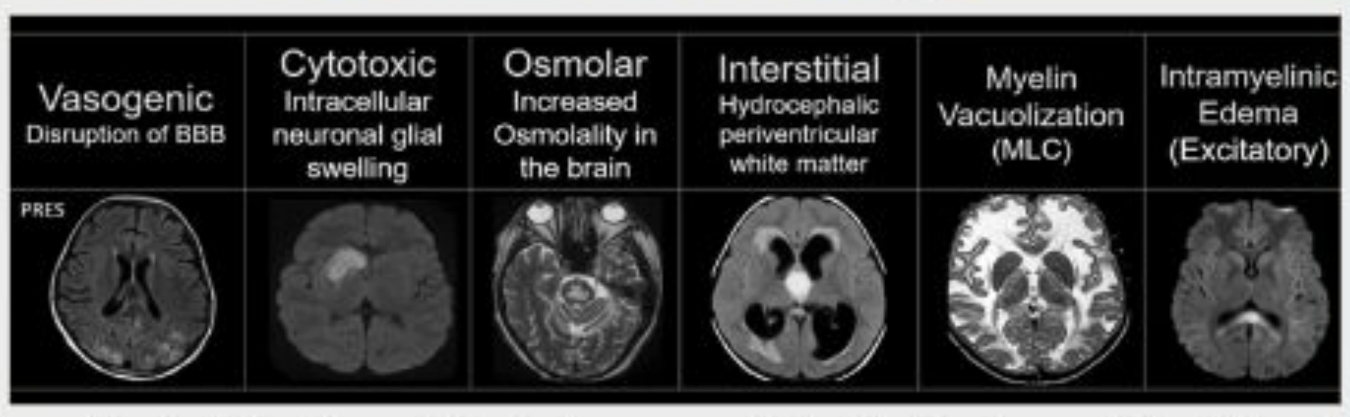
- In cardiac arrest, the heart stops bleeding suddenly, which can lead to devastating hypoxic-ischemic(lack of oxygen) brain injury leading to an accumulation of fluid into injured tissue, called cerebral edema.
- Often, cerebral edema is hard to detect early and accurately, leading to late diagnosis. Additionally, preventing it is challenging given the unknown associations of other variables with cerebral edema.

## Objectives



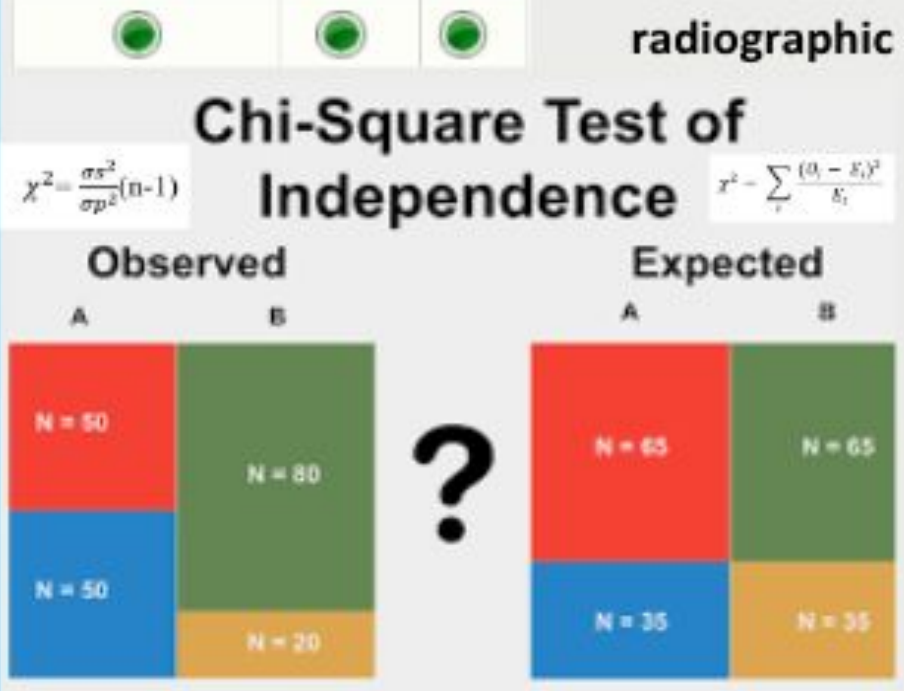

## Data Collection/Methodology

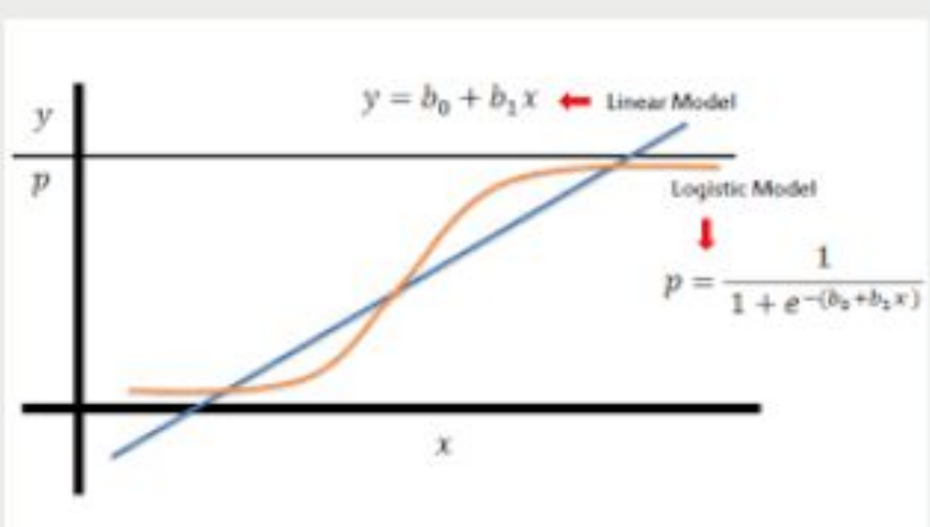



- Data filtration of Database provided in Redcap with clinical data(Demographics, Discharge, Cerebral Edema) and CCI scores filled out shown to the left
- Identification of Cerebral Edema patients through radiographic review(MRI and CT scans) shown above

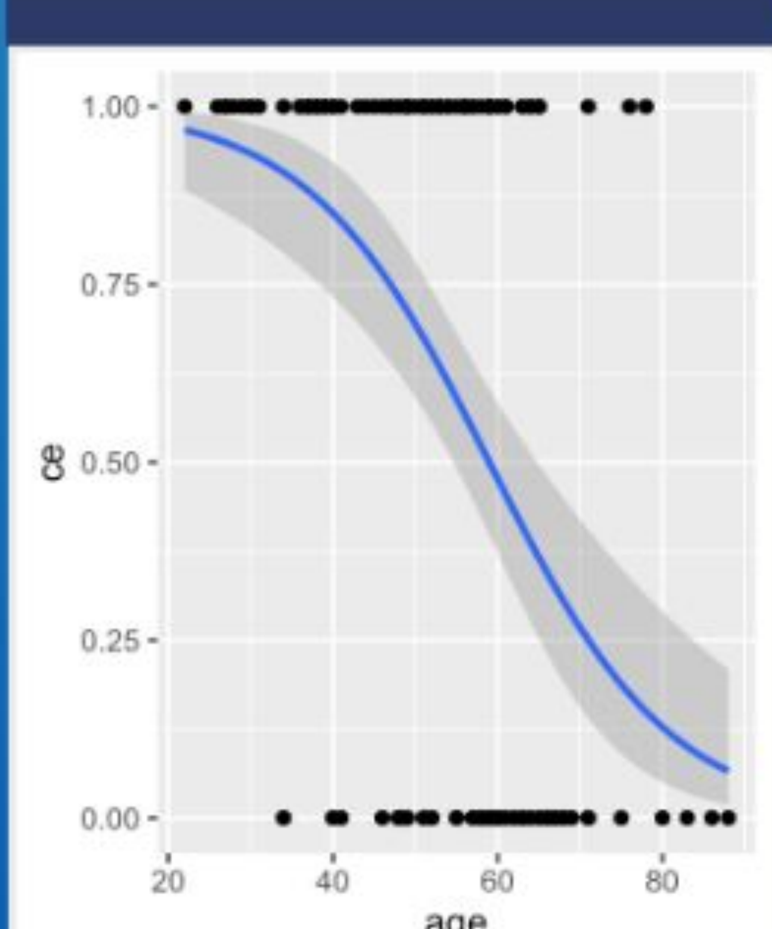
### Chi-Square Test of Independence




- Graphical Interpretation of exported Excel sheet of redcap collected data.
- Determined use of Chi-squared tests to assess the univariable association and find correlations between pre-existing characteristics and cerebral edema
- Logistic Regression with results reported as a 95% confidence interval of the odds ratio. to estimate the associations between illness severity factors and future cerebral edema adjusted through sex (S-shaped graph)

## Data Analysis





To the left is a logistic regression graph comparing age to ce showing an inverse relationship. 1) Diabetes vs CE 2) CKD vs CE 3) CVA vs CE 4) MI vs CE (age as an index).

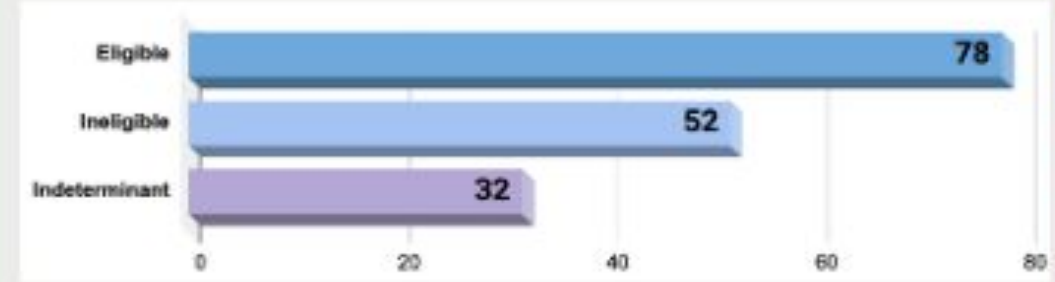
## Visual Abstract

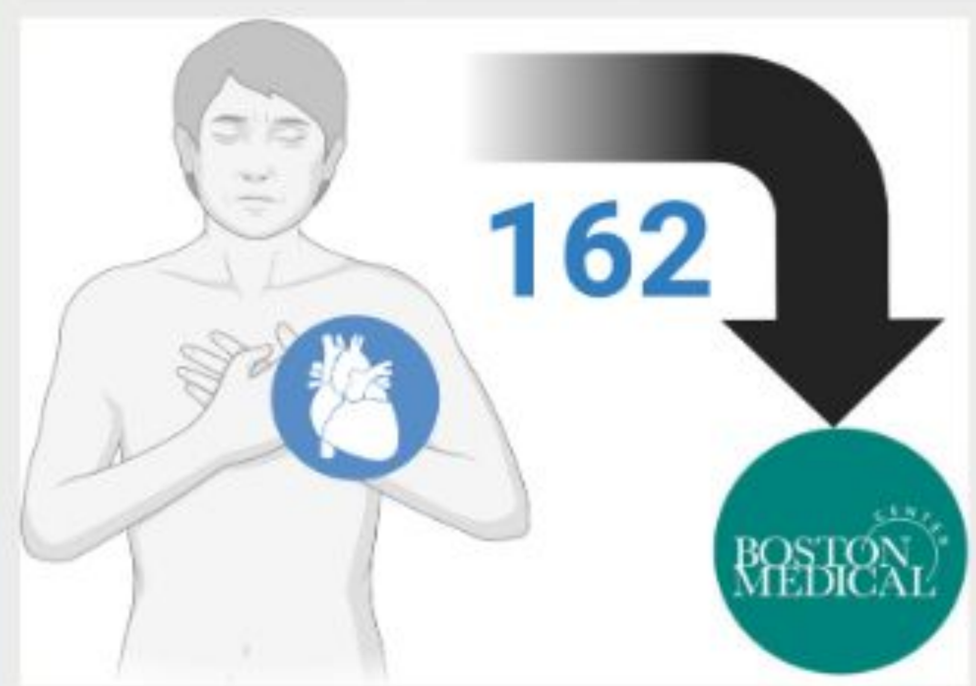
## Hypothesis

An increase in age, solid tumors in the brain, and diabetes mellitus will contribute to the development of cerebral edema because of the decreased blood flow rate, leading to blockage and buildup of fluid or blood.

## Population/Variables

- 162 Patients Post Cardiac Arrest was admitted to BMC between 2016 and 2023 (78 with cerebral edema 52 without cerebral edema, and 32 indeterminant).
- Charlson Comorbodity Index Variables were used, listed below




| Condition | Weight [points] |
|---|---|
| Myocardial infarction | 1 |
| Congestive heart failure | 1 |
| Peripheral vascular disease | 1 |
| Cerebrovascular disease | 1 |
| Dementia | 1 |
| Chronic pulmonary disease | 1 |
| Connective tissue disease | 1 |
| Peptic ulcer disease | 1 |
| Mild liver disease | 1 |
| Diabetes without complications | 1 |
| Hemiplegia | 2 |
| Moderate to severe renal disease | 2 |
| Diabetes with end organ damage | 2 |
| Any tumor | 2 |
| Leukemia | 2 |
| Lymphoma | 2 |
| Moderate to severe liver disease | 3 |
| Metastatic solid tumor | 6 |
| AIDS | 6 |

## Statistical Analysis

| CCI Factor | Correlation Coefficient | P Value |
|---|---|---|
| Myocardial Infarction | -.0049 | 0.96 |
| Congestive Heart Failure | 0.109 | 0.21 |
| Peripheral Vascular Disease | -0.102 | 0.25 |
| Cerebrovascular Accident | -0.090 | 0.31 |
| Peptic Ulcer Disease | -0.080 | 0.36 |
| Gray-White Differentiation | 0.384 | 0.01 |
| Complete Basilar Cistern Effacement | 0.596 | 0.60 |
| Herniation | 0.255 | 0.26 |
| AIDS | 0.132 | 0.13 |
| Chronic Obstructive Pulmonary Disease | 0.085 | 0.33 |
| Chronic Kidney Disease | 0.085 | 0.02 |
| Cumulative trauma disorders | -0.023 | 0.79 |

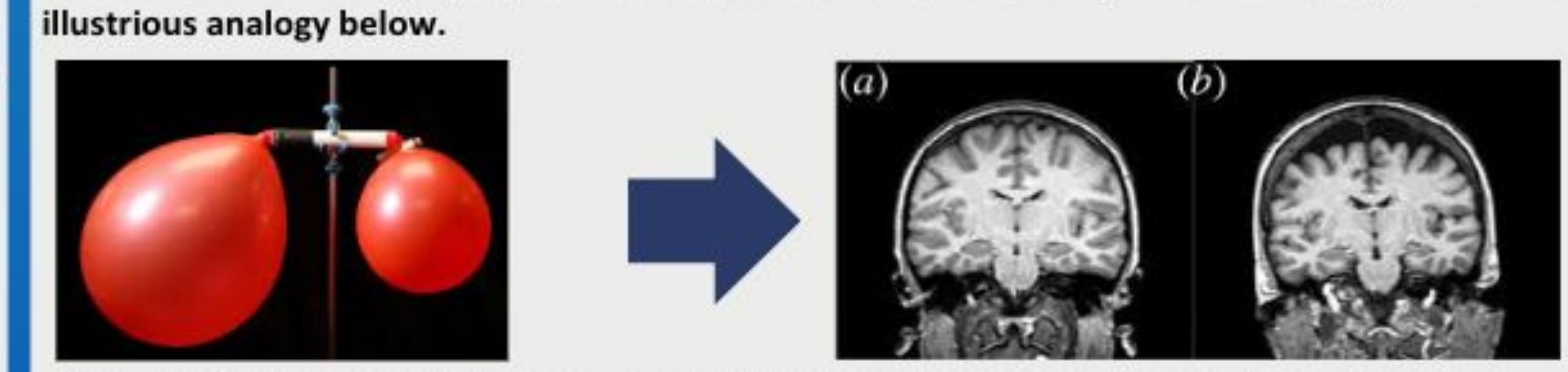
| Factor (X=Not Affected), Y= Affected) | Cerebral Edema (N=78) | Non-Cerebral Edema (N= 51) |
|---|---|---|
| Age | Mean =48.19 STD: 12. 53 | Mean 60.5 STD: 10.86 |
| Sex | F=40% M= 60% | F=37% M =73% |
| MI | X=96 % Y=4% | X= 84% Y=16% |
| CHF | X= 86% Y=14% | X= 82% Y=18% |
| PVD | X=94% Y=6% | X= 69%Y=31% |
| CVA | X=99% Y=1% | X= 88% Y=12% |
| COPD | X=92% Y=8% | X=86% Y=14% |
| CTD | X=99% Y=1% | X= 92% Y=8% |
| PUD | X=100% Y=0% | X=94% Y=6% |
| Diabetes Mellitus | X=77% Y=23% | X=65% Y=35% |
| CKD | X=88% Y=12% | X=78% Y=22% |
| Solid Tumor | X=99 %Y=1% | X=82% Y=18% |

| Values | Age |
|---|---|
| Estimate | -0.0168 |
| Std. Error | 0.00291 |
| T Value | -5.79 |
| Pr(>\|t\|) | 5.26 x 10^-8 |

Statistical tables are displayed generated from R. Above is logistic regression data for age(statistically significant), left are Chi Squared Values, and middle are Data Characteristics

## Conclusions

Contrary to my initial hypothesis, younger age had a statistically significant association with cerebral edema development, suggesting that older patients may be less likely to experience fulminant edema after cardiac arrest. Other factors didn't have a statistically significant association with cerebral edema. Younger people are more prone to cerebral edema, which can be explained in an illustrious analogy below.




Similar to ballons, as individuals age, their brains occupy less space and develop some separation from skull. Thus in a "deflated state", older people, even with the influx of fluid, are less prone to cerebral edema due to the greater empty space in the brain

## Key References

CR;, C. M. P. K. (n.d.). A new method of classifying prognostic comorbidity in Longitudinal Studies: Development and validation. Journal of chronic diseases. https://pubmed.ncbi.nlm.nih.gov/3558716/

Nehring SM, Tadi P, Tenny S. Cerebral Edema. [Updated 2023 Jul 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK537272/

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## Future Work

- Future studies on studying differences in brain structure, vascular permeability, and the role of age-related differences in brain metabolism
- Future studies assessing neurological outcomes in younger versus older patients
- Comparing the differences in blood flow in younger and older patients, focusing on differences in cerebral Blood Brain Barrier and inflammatory responses