

2-2021

Nutritional Intervention in Concussion Treatment and Analysis Using MRI and EEG

Jideofor Okafor

Thomas Jefferson University, jideofor.okafor@students.jefferson.edu

Namdi Nwasike

Thomas Jefferson University, namdi.nwasike@students.jefferson.edu

Andrew Newberg, MD

Thomas Jefferson University, Andrew.Newberg@jefferson.edu

Follow this and additional works at: https://jdc.jefferson.edu/si_phr_2023_phase1



Part of the [Public Health Commons](#)

[Let us know how access to this document benefits you](#)

Recommended Citation

Okafor, Jideofor; Nwasike, Namdi; and Newberg, MD, Andrew, "Nutritional Intervention in Concussion Treatment and Analysis Using MRI and EEG" (2021). *Phase 1*. Paper 8.

https://jdc.jefferson.edu/si_phr_2023_phase1/8

This Article is brought to you for free and open access by the Jefferson Digital Commons. The Jefferson Digital Commons is a service of Thomas Jefferson University's [Center for Teaching and Learning \(CTL\)](#). The Commons is a showcase for Jefferson books and journals, peer-reviewed scholarly publications, unique historical collections from the University archives, and teaching tools. The Jefferson Digital Commons allows researchers and interested readers anywhere in the world to learn about and keep up to date with Jefferson scholarship. This article has been accepted for inclusion in Phase 1 by an authorized administrator of the Jefferson Digital Commons. For more information, please contact: JeffersonDigitalCommons@jefferson.edu.

Nutritional Intervention in Concussion Treatment and Analysis Using MRI and EEG

Namdi Nwasike, Jideofor Okafor, Andrew Newberg*,
MD***

Introduction & Objectives

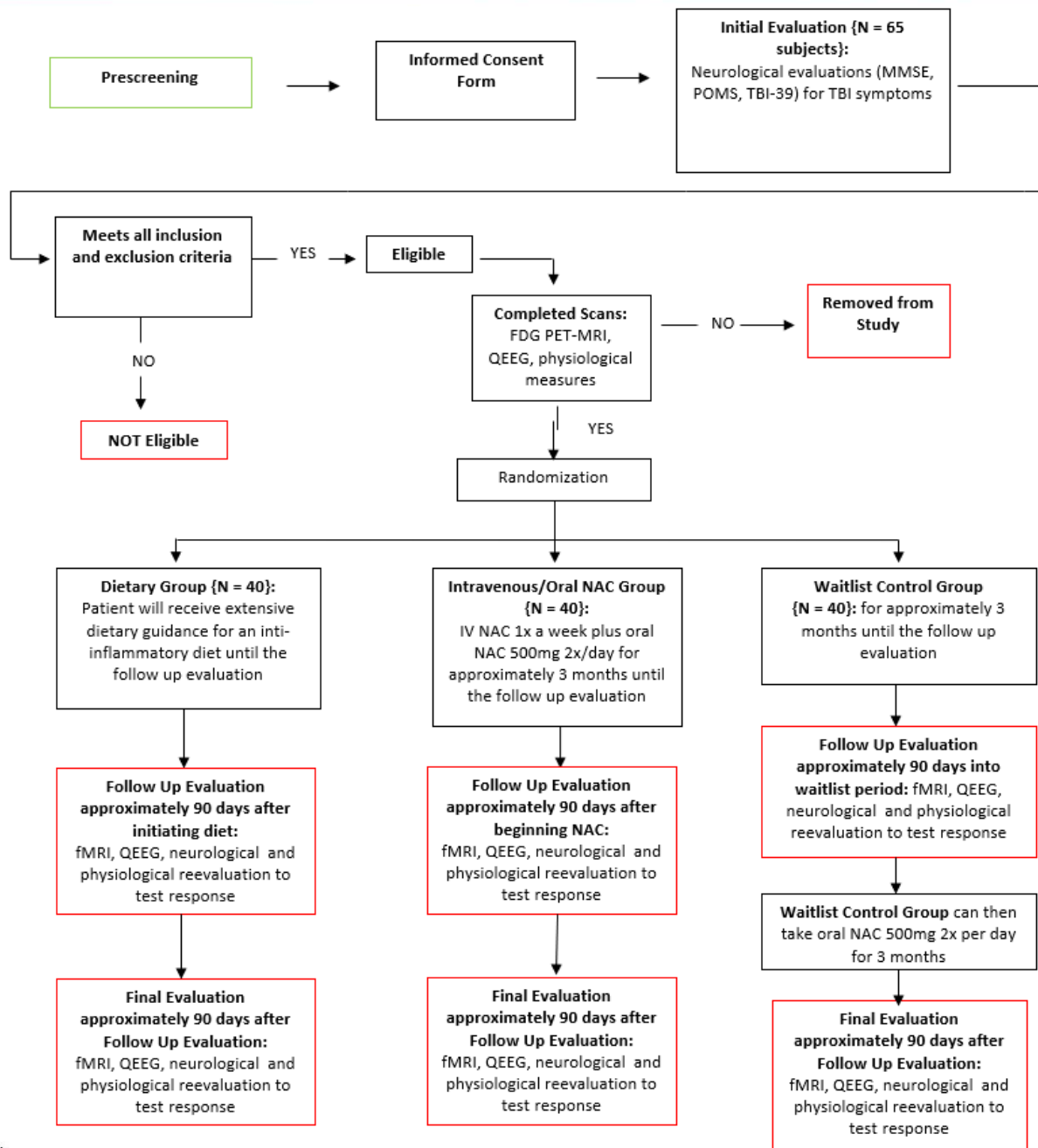
- Over 1.5 million Americans suffer traumatic brain injuries annually resulting in over 50,000 deaths, 300,000 hospitalizations, and 80-90 thousand individuals with long term disability (Chronic Traumatic Brain Injury [cTBI])
- Accidental falls and vehicle crashes were the most common causes of TBI (52.3 and 20.4% of TBI hospitalizations respectively), TBI is more common among adults older than 55, and the lifetime economic cost of TBI is approximately \$76.5 billion.
- There is a lack of studies using comprehensive diagnostic imaging tools to better understand physiological ramifications of the injury that may help guide therapy

Introduction & Objectives

- The brain has difficulty withstanding substantial amounts of oxidative stress. Glutathione is an important reducing agent in the neurons, which is found to be depleted in the brain of TBI patients.
- N-Acetylcysteine (NAC) replenishes glutathione levels, and an anti-inflammatory diet may reduce oxidative damage

Intro and Objectives

- The purpose of this project will be to create the first comprehensive, and extensive longitudinal diagnostic evaluation of cTBI patients using a battery of neurocognitive tests, plasma levels of specific inflammatory compounds, and the use of functional MRI, PET, and quantitative EEG.
- Inquiry Question: Will NAC supplementation or an anti-inflammatory diet be better for cerebral recovery in TBI patients, as visualized by MRI/EEG. This specifically is our goal.



Methods

- IRB was approved
- 89 subjects recruited from the greater Philadelphia area
- Subjects divided into 3 groups: NAC, Nutrition, Waitlist control
- Subjects further divided into responders and non-responders
 - Responders: subjects who had significant improvements of at least 10 points based on pre- and post-treatment responses on the Rivermead Post-Concussion Symptoms Questionnaire
- Initial Evaluation for all subjects:
 - FDG PET, fMRI, QEEG, Physiological measures, and Neurocognitive and psychological testing
- Follow-up Evaluation at 3 months and Final Evaluation at 6 months:
 - Same as Initial Evaluation, without FDG PET

Study Groups

- **NAC supplementation group**
 - Will receive a combo of oral + IV NAC for 3 months
 - Doses will be prepared for each patient by the study nurse, 50 mg/kg
 - Can pursue additional standard of care treatment for any residual symptoms after 3 month follow-up evaluation, then undergo final evaluation at 6 months from initial intervention
- **Nutrition (anti-inflammatory diet) group**
 - Dietary counseling will take place reviewing all food intake and providing a handout with dietary recommendations
 - Subjects will be asked to keep a food diary for 1 week each month using myfitnesspal.com with a given subject username and password
 - Subjects will be contacted every 2 weeks for additional guidance and support
 - Can pursue additional standard of care treatment for any residual symptoms after 3 month follow-up evaluation, then undergo final evaluation at 6 months from initial intervention
- **Waitlist control group**
 - Will receive standard of care for 3 months

Procedures

- **FDG PET**
 - Only done initially to minimize risk of radiation exposure
 - Used to evaluate initial brain function and to assess for focally increased or decreased metabolism
- **MRI**
 - Used to assist with anatomic delineation (co-registered with PET) and obtain data assessing functional connectivity and brain volumes
- **QEEG**
 - Used for accurate determination of origin of electrical signals in the brain and to assess brain activity
- **Physiological and clinical measures**
 - Heterogenous Random Coefficients Model will be fit for the physiological values, and each neurocognitive score to accommodate the longitudinal nature of the data
 - Measuring levels of inflammatory markers
- **Neurocognitive and psychological testing**
 - Subjects will be administered the **Rivermead Post-Concussion Symptoms Questionnaire**, as well as assessments for anxiety, depression, cognition, sleepiness, and adaptability

Comparisons Using MRI and EEG

- Cerebral blood flow (CBF, ml/100g/min) was compared between subjects in various brain regions via MRI
- Subjects were compared via EEG based on initial delta- and theta-wave values
 - Compared Relative Power, Absolute Power, and Coherence between subject
- Responders vs Non-responders compared using T-tests to obtain p-values

Results

Modality	Nutrition Responders	NAC Responders
MRI	Lower CBF in anterior cingulate	Higher CBF in inferior frontal lobe
EEG	Lower initial delta-wave relative power	Higher initial delta- and theta-wave coherence

- MRI
 - Nutrition p-value = 0.042
 - NAC p-value = 0.084
- EEG
 - Nutrition:
 - Delta-wave Relative Power - 14/16 electrodes with p-values <0.05
 - NAC:
 - Delta-wave Coherence - 17/56 electrodes with p-values <0.05
 - Theta-wave Coherence - 33/56 electrodes with p-values <0.05

Conclusions

- **MRI**
 - It appears that both nutrition and NAC have certain impacts on the brain, but only if that area of the brain was already injured. Despite this observation, it is currently unclear as to whether NAC or nutrition is better for reversing cerebral damage in TBI patients. However, NAC's p-value was not significant, therefore the results are inconclusive.
- **EEG**
 - Depending on initial EEG patterns, a patient may benefit more from NAC or Nutrition treatment

Conclusions - Limitations

- Low sample size
 - MRI
 - 12 Responders total - 6 NAC, 6 nutrition
 - 12 Non-responders total - 6 NAC, 6 nutrition
 - EEG
 - 9 Responders total - 5 NAC, 4 Nutrition
 - 10 Non-responders total - 6 NAC, 4 Nutrition

Conclusions - Next Steps

- MRI
 - Collect data from more subjects to see if a definitive best therapy can be decided
- EEG
 - Collect data from more subjects to see if responsiveness patterns stay consistent
 - Compare impact of treatments between subject groups

Disclosures and Acknowledgements

- Conflict
 - Could not obtain all data that was previously collected
- Acknowledgements
 - Marcus Institute of Integrative Health



Jefferson

Philadelphia University +
Thomas Jefferson University

HOME OF SIDNEY KIMMEL MEDICAL COLLEGE