Can Post-concussion symptom inventory (PCSI) scores within 2 weeks of concussion predict prolonged headache following concussion in youth?

Preregistration 3/9/2021

**STUDY TYPE:** retrospective analysis of prospective cohort

**HYPOTHESIS:** High headache and migrainous (light sensitivity, sound sensitivity, nausea, and dizziness) PCSI scores will be predictive of prolonged headache (at least 28 days)

**STUDY DESIGN**

Inclusion criteria:

* Age 11-21
* Diagnosed with concussion
* First clinic visit was within 2 weeks of concussion with recorded PCSI scores
* Filled out the teen PCSI
* Was followed for at least 28 days or recovered (see definition below) within 28 days
* All visits that were collected within 400 days of date of injury with a PCSI score will be included

Comparison groups:

1. Post-traumatic headache (PTH) group: subjects who report persistent headache that lasts at least 28 days defined by a PCSI headache score of 1 or greater
2. Recovered group: subjects who report post-concussion symptom recovery within 28 days, defined as a PCSI score of 3 or less and headache score of 0
3. Post-concussion symptoms (PCS), no headache group: subjects who have a PCSI score of greater than 3 at 28 days, but a headache score of 0

**ANALYSIS**

Subjects will be randomly and evenly split into a development and validation dataset (similar percentage of biological sex and similar age, similar family and personal history of migraine, and similar percentage of PTH and recovered subjects).

The development group will be used to identify PCSI symptoms, and past family and medical history important for predicting prolonged headache. Polychoric factor analysis will be used to reduce dimensionality of the PCSI dataset. The analysis will be run twice, once including past medical and family history, and once with just the PCSI scores. Dimensions that correlate with the prolonged headache group will be used to develop a support vector machine (SVM) classifier. Different kernels will be tested to separate the PTH, recovered, and PCS without headache groups. The kernel that is most effective at separating out the groups will be used.

The validation dataset will be used to determine if the SVM classifier developed is generalizable to youth not directly used in the development of the model. The primary outcome measure will be percent of correctly classified subjects.

Sub-analyses

1. Subjects with pre PCSI scores, evaluate pre PCSI score subtracted values
2. Subjects who filled out the surveys at the 1 month, 6 month, and 1 year data points
3. PCSI headache score severity in the PTH group: mild/moderate (score of 1 to 3), moderate/severe (score of 4 to 6)
4. 24 subjects were also seen in general neurology/headache clinic who filled out the CHOP headache welcome form (9 of which had PCSI scores collected within 2 weeks of concussion) have additional information about headache characteristics including duration, severity, quality, location, frequency, and associated features.
5. Determine if family and personal history of migraine are predictive of prolonged headache in this cohort

**LIMITATIONS**

* PCSI preinjury is based on recall
* PCSI scores were collected at various time points, and subjects who filled out the PCSI as part of a clinic visit are going to still be symptomatic and thus will have higher PCSI scores