Post-Concussive Visual Symptoms in Teens Undergoing Rehabilitation

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Introduction

- Between 2002 and 2006, there were 473,947 pediatric (ages 0-14) TBI-related emergency department visits annually.[1] In previous studies looking at adolescent post-concussive visual symptoms, it was shown that 69% of those studied had one or more visual diagnoses, including accommodative disorders (deficits in binocular vision), convergence insufficiency (difficulty focusing), and saccadic dysfunction (difficulty with eye movements).[2] These visual difficulties have been associated with reported academic difficulty in adolescents.[3]

- To better diagnose concussions in the future as well as to understand how concussions affect academics, it is important to look at the full spectrum of visual symptoms present. The goal of this study is to assess the frequency of less commonly tested and reported visual symptoms in adolescents, in order to better categorize possible visual symptoms following concussion.
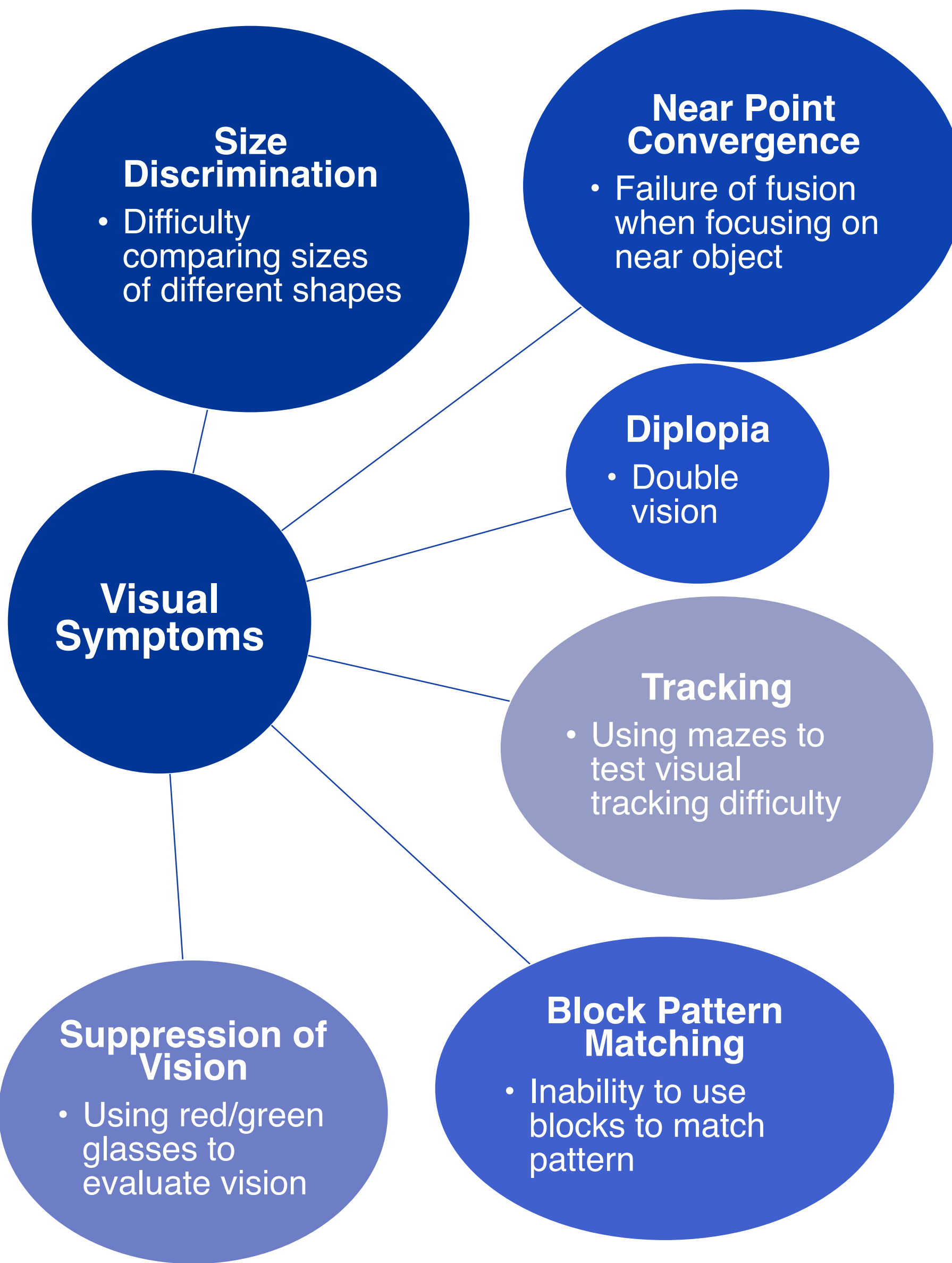
Size Discrimination
- Difficulty comparing sizes of different shapes

Near Point Convergence
- Failure of fusion when focusing on near object

Visual Symptoms

Diplopia
- Double vision

Tracking
- Using mazes to test visual tracking difficulty

Suppression of Vision
- Using red/green glasses to evaluate vision

Block Pattern Matching
- Inability to use blocks to match pattern

Figure A: Assessed visualized symptoms.

Aims and Objectives

- **Aim 1:** Identify common visual symptoms seen in teenagers undergoing post-concussive rehabilitation.
  - Assess the frequency of six visual symptoms (Figure A) seen in teenagers who have been diagnosed with a concussion:

- **Aim 2:** Identify if visual symptoms seen in teenagers are related to demographic factors.
  - Use statistical analysis to identify any correlation between visual symptoms and sex or age.

Methods

- Retrospective chart review utilizing medical record data of teenage patients, between the ages of 13 and 18, from a physical medicine and rehabilitation center
- Patient's sex and age were documented
- Symptoms were recorded based on a binary scale of present or absent and included:
  - Size Discrimination Difficulty
  - Near Point Convergence Difficulty
  - Diplopia
  - Difficulty with Tracking
  - Block Pattern Matching Difficulty
  - Suppression of Vision
- Data was subjected to chi-squared analysis of independence to assess for any associations between either sex or age and presence of symptoms.
- For the purpose of analysis, ages were grouped into the following:
  - Young (13-14 years of age)
  - Mid (15-16 years of age)
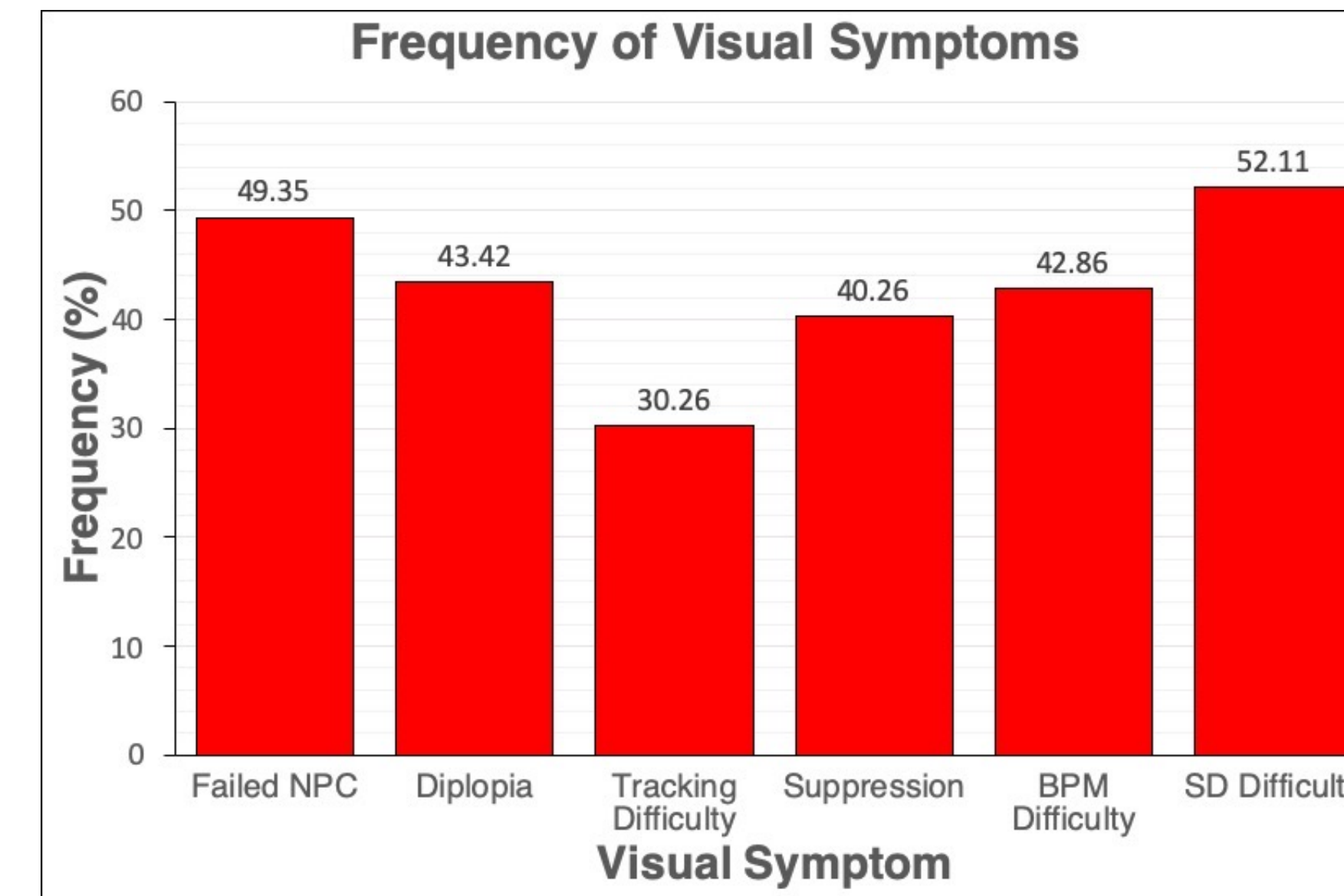 - Old (17-18 years of age)

Results

Frequency of Visual Symptoms

Figure B: Total frequency of visual symptoms in the sample. NPC: Near point convergence. BPM: Block pattern matching. SD: Size discrimination.

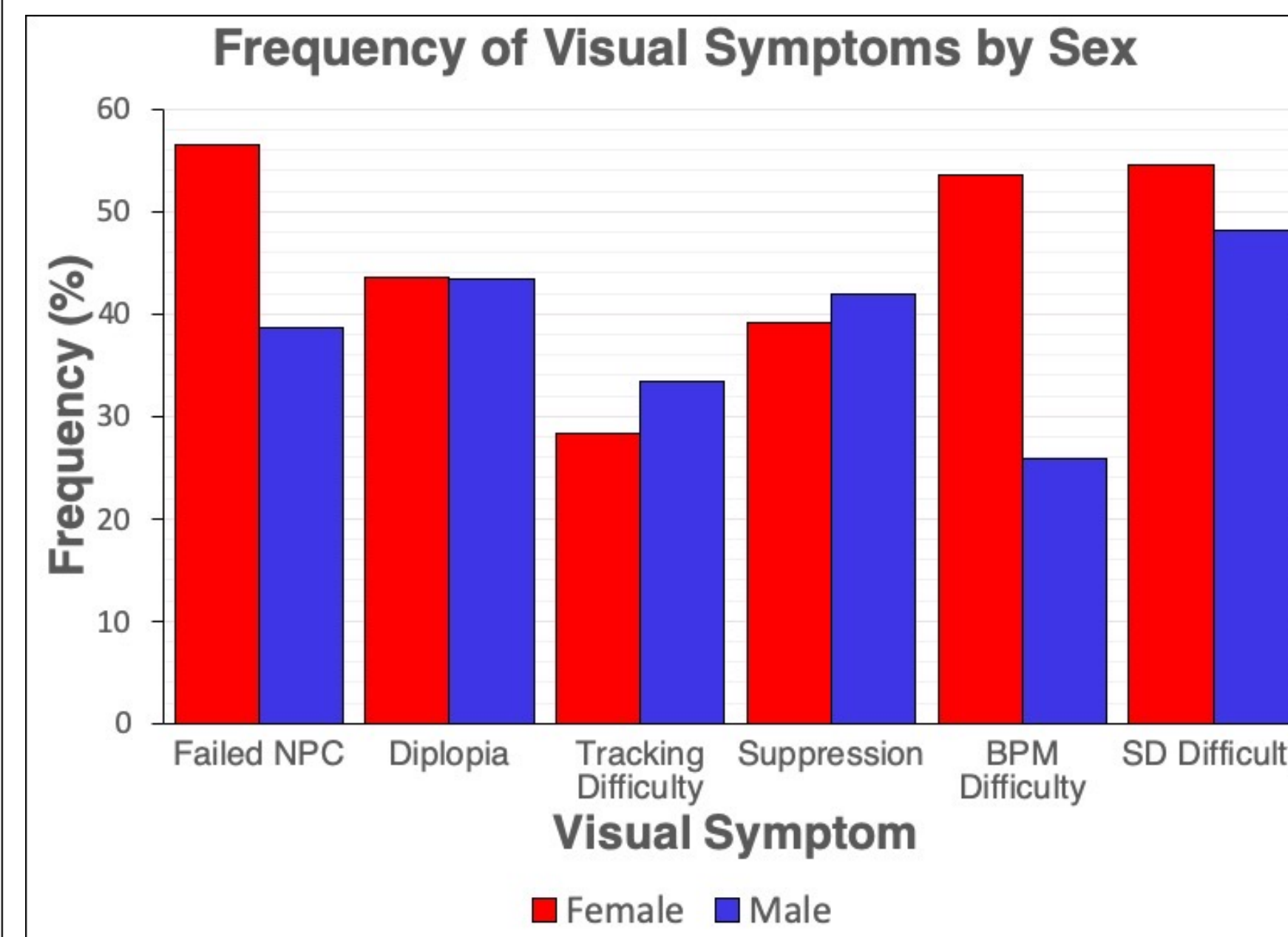### Frequency of Visual Symptoms by Sex

Figure C: Frequency of visual symptoms in both sexes. NPC: Near point convergence. BPM: Block pattern matching. SD: Size discrimination.

- There was no significant difference in symptoms between the age groups. The only significantly different symptom between sexes was difficulty with block pattern matching, seen more in females ($X^2(1, N=70) = 5.1$, $p = 0.023$).
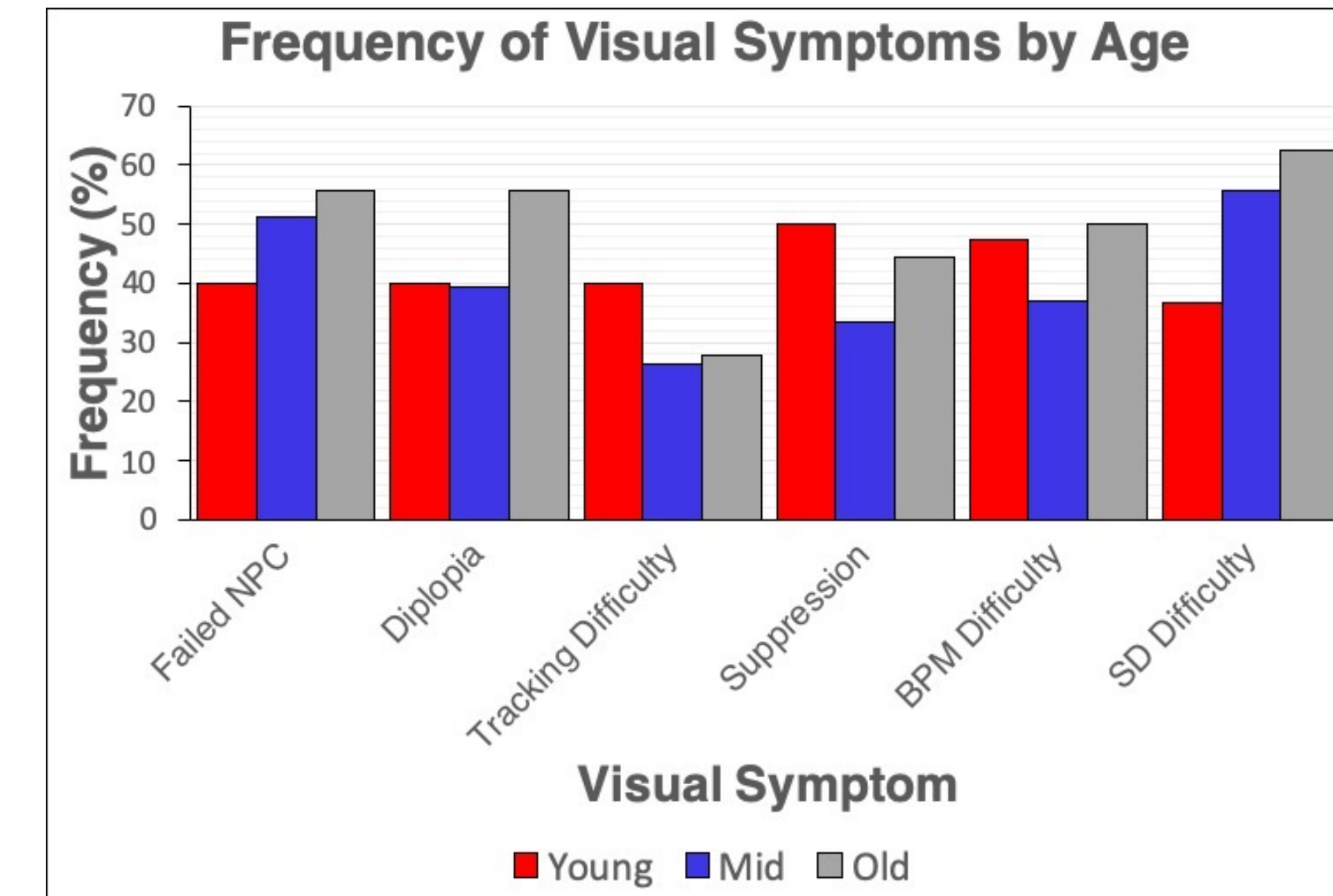
Frequency of Visual Symptoms by Age

Figure D: Frequency of visual symptoms in all age groups. NPC: Near point convergence. BPM: Block pattern matching. SD: Size discrimination.

Conclusions

- Visual disturbances can be underestimated in their impact on children and adolescents post concussion. There are a wide range of visual irregularities amongst our population, but one that is commonly unrecognized and underreported in the literature, is estimation of size and size discrimination. The frequency to which these symptoms are seen could explain some of the difficulty with academics many post-concussive teens have. Acknowledged limitations with our data relates to absence of a comparison control group. Further research should focus on controlled studies to see how common these symptoms are compared to a healthy population. Perhaps, in the future, the presence of these symptoms could be used in the diagnosis of post-concussion academic and cognitive decline post trauma.

References

1. Faul M, Xu L, Wald M, Coronado V. Traumatic Brain Injury in the United States.; 2002. www.cdc.gov/TraumaticBrainInjury. Accessed April 29, 2019.
2. Master CL, Scheiman M, Gallaway M, et al. Vision Diagnoses Are Common After Concussion in Adolescents. Clin Pediatr (Phila). 2016;55(3):260-267. doi:10.1177/0009922815594367
3. Swanson MW, Weise KK, Dreer LE, et al. Academic Difficulty and Vision Symptoms in Children with Concussion. Optom Vis Sci. 2017;94(1):60-67. doi:10.1097/OPX.0000000000000977

Acknowledgements

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