BRAIN INJURY VISION SYMPTOM SURVEY (BIVSS): PRELIMINARY COMPARISON DATA AND RASCH ANALYSIS

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ABSTRACT
The BIVSS is a 28-item scaled survey designed to query vision behaviors related to: clarity, comfort, diplopia, depth perception, dry-eye, peripheral vision, & reading with individuals who have suffered mild-to-moderate brain injury.

Anonymous BIVSS data were analyzed from 219 individuals (62 TBIs & 157 non-TBIs). TBI results significantly differed from non-TBIs. A raw BIVSS score of ≥45 was determined as discriminative of a significant visual problem for the 28-question survey.

TBI completion success:
• 93.5% of TBI subjects able to complete at least 27 questions

Non-TBI completion success:
• 100% of subjects able to complete all 28 questions

Rasch analysis identified 10 of the 28-questions as either redundant or as misfit. Analysis of the reduced set of 18-questions yielded excellent specificity (96%), good overall accuracy (90%), and moderate sensitivity (76%). For the 18-question reduced set, a raw score of ≥28 was determined as discriminative of a significant visual problem.

Whereas Univariate Rasch Analysis assumes only a single factor, Factor Analysis of the 28-item responses suggested up to 5-underlying dimensions potentially.

RESULTS
Total Scores (Raw Sums) of 28 BIVSS Questions
- Areas represent the 20th to 70th percentiles. Bars in the center are the medians
- Lightening between current TBI patients (both and non-va) and normal optometry students
- Overall non-parametric Kruskal-Wallis comparison of 5 TBI groups was significant, p<.001
- 3 years has had a significant effect on different distributions than the 3 year optometry students (n=20, Wilcoxon), but the median test was not significant between the two groups (p=.20).

Rasch Analysis
- 10 items were removed from the original cl to reveal a total of 18 items with separation of 0.92
- Fixed 18 questions
- Plots of item difficulty against the expected difficulties for the 18 questions
- Item discrimination index (DI) and item difficulty parameter (DT)
- Plots of item parameter against the expected parameter values for the 18 questions

Misfit Analysis
- Table 2: Misfit analysis of the 18-item BIVSS responses
- Table 3: Misfit analysis of the 28-item BIVSS responses

Group Comparison for Total Sum of BIVSS for the Reduced Set of 18 Questions
- The overall Kruskal-Wallis non-parametric test was significant (p<.001)
- The Wilcoxon statistic (t-test) for the median test indicated a difference between optometry student groups
- Neither the Wilcoxon (distributions) nor the median test indicated a difference between TBI patient groups.

Consideration of questions not included in the Rasch Primary Dimension
- Table 4: Consideration of questions not included in the Rasch Dimension
- Multivariate ANOVA analysis
- Table 5: Results of the multivariate ANOVA analysis

CONCLUSIONS
Most all mild-to-moderate TBI can complete the BIVSS
There was significant mean score separation between TBI & non-TBI groups (on both 28 & 18-item versions)
• No diff between soldier vs. non-soldier TBI groups
• No diff btw 1st vs. 3rd yr. non-TBI opt students on 18-item BIVSS, but groups differed on 28-item BIVSS
• 8/10 questions not included on abbreviated BIVSS contributed to discriminating 1st vs. 3rd yr. non-TBI opt student groups

BIVSS raw scores mirror Rasch computed scores, so use of raw scores may be clinically appropriate

Specificity = 96% / sensitivity = 76% / accuracy = 90%
The 18-item version better at discrimination with higher total scores, but less so with lower raw score totals
• Most likely to miss TBIs with low-level symptoms

The cutoff scores (indicating a significant vision problem) were 45 & 28 (for the full 28-item BIVSS & the 18-item reduced set, respectively)

Rasch analysis assumes a single dimension drives the responses to all of the questions. Factor analysis of the 28-item BIVSS results suggested multiple underlying factors may have contributed
• To confirm, a larger BIVSS TBI database is needed

BIVSS scores appear to trend downward as a function of time since the brain injury
Future research with the BIVSS is planned

DISCLAIMER
- The BIVSS appears to have a very clear association with TBI, but it is not diagnostic. There are other vision problems that may arise with the BIVSS.
- We use the sum of the BIVSS as a convenient scoring method for clinicians after excluding questions based on Rasch analysis.
- There was missing data. Missing values were filled in by the investigator of the form that questions across subjects within a group mean the values of the answers for that subject.

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