A Systematic Review and Meta-analysis of the Prevalence of Depression after Traumatic Brain Injury (TBI)

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Introduction

TBI: An insult to the internal brain from external forces resulting in permanent/temporary impairment [1]. 64 million hold diagnosis [2]

Secondary Conditions: Neuropsychiatric conditions most common includes depression, anxiety, PTSD [3]

Gap in the Literature

Prevalence Rates: High heterogeneity in the findings, large quantity of literature, narrative review found post-TBI depression ranges from 11-42% [4]

Factors Moderating Prevalence Rates: High of heterogeneity relating to factors moderating prevalence. Location, population, severity of TBI, age, diagnostic measures of depression etc

Previous Literature:

Osborn et al. 2014 [5]: Found: 27% of ppt diagnosed with depression following TBI, Limitations: Only non-penetrating TBI, did not evaluate severity of TBI, took place 10 years ago

Ganesh et al. 2024 [6]: Found: 35% of ppt diagnosed with depression following TBI, Limitations: Only included studies in the Global South

Aim

1) To conduct a systematic review + meta-analysis to provide an up-to-date, global prevalence rate
2) To identify and test moderators of prevalence rates

Overall objective: Utilise knowledge of prevalence rates and moderators to guide clinical practice and increase awareness of high-risk groups within TBI populations

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Method

- Pre-registered on PROSPERO (CRD42024499164)
- Follows PRISMA 2020 guidelines
- All data can be found online at https://github.com/OriellaS-TBI/TBI_depression_meta
- Part of a larger project: prevalence rates of depression, anxiety and PTSD within TBI populations
- Focus of this report: prevalence rates of depression in TBI populations

Databases: PsychINFO, MEDLINE, CINAHL
Search Terms:

Brain injury	Mental health	Characteristics
("Brain Injuries, Traumatic" OR "Brain Concussion" OR TBI OR "traumatic brain injur*" OR "brain injur*" OR "cerebral trauma" OR "craniocerebral injur*" OR concussion*)	("mental health" OR "mental disorder*" OR "mental illness" OR neuropsychiatr* OR psychiatr* OR psychopatholog* OR depress* OR dysthymia OR mood OR anxiety OR "obsessive compulsive" OR "obsessive-compulsive" OR OCD OR phobia OR phobic OR panic OR agoraphobia OR PTSD OR "posttraumatic stress" OR "post-traumatic stress")	(adult* OR "young adult*" OR elderly) AND (humans [Filter] AND English[Filter]).

Inclusion/exclusion:

Inclusion	Exclusion
Diagnosis of TBI	If TBI can't be differentiated from other non-TBI conditions
All severities (mild-severe)	
Adults (+18)	Meta-analyses, literature reviews, systematic reviews, case report/series, qualitative studies, opinion pieces, book chapters
Any gender	
Reporting prevalence of depression	
English Language	Studies with <100 ppt

Data Extraction:

Exposures: Number of cases of TBI
Outcomes: Cases of depression per population of those with TBI
Study characteristics: published year, location, TBI diagnosis methods, setting, TBI severity, study design, mean age, % females, quality score, access duration, depression diagnosis, name of scale, cut-off score
Quality assessments - Kmet et al. (2004) [7] 14 items, 3-point scale (criteria not met – fully met), score: low = ≤12, moderate 13-16, high ≥17

Statistical Analysis:

- Conducted in *R,* using *meta* and *dmetar* packages, calculated with DerSimonian-Laird estimator [8]
- Subgroup analyses (categorical): study design, TBI severity, depression measurement technique, study setting, population + continent
- Meta-regressions (continuous): age, gender, year of publication, severity of TBI + quality of included
- Sensitivity tests: Outlier, influence analysis, Leave-1-out sensitivity test [9]
- Publication bias: funnel plot and Egger's test [10]

Results

Prisma 2020 Flow Diagram

- Initial search = **10,632**
- PsychINFO (n = **4045**), MEDLINE (n = **4662**), CINAHL (n = **1925**)
- Duplicates (n = 3664) removed with Rayyan + manual checking
- 6968 abstracts/titles screened, 6413 excluded
- 555 studies put forward for full-text, 357 full text excluded
- Reasons: wrong outcome of interest, unclear exposure, sample size <100, <18 ppt, prior psychotic disorder, study design, self-reported
- Outcome: **165 included papers**

Characteristics

Study Characteristics	Participant Characteristics
165 papers (1977 – 2023)	General public (n = 123), veterans (n =26), active military personnel (n = 11) or an athletes (n = 5)
Mode year = 2018	% female = 18 – 87.6%
Pooled sample size = 2,648,289 (100 – 1,141,593)	Inpatient (n = 32), outpatient = (n = 57), both (n = 33), community (n = 43)
Most designs = cross-sectional (n = 68)	Questionnaires (n = 107), clinical diagnoses (n – 58), PHQ was most common (n = 34)
Most conducted in the USA (n = 104)	

Synthesis of Results

- Random effects model: **27%** (95% CI 25-29%) (1 in 3 –1 in 4 of those with TBI)
- High, **significant** heterogeneity ($I2$ = 100%, $\tau2$ = 0.0182, p = 0)
- Quality assessment: Low (n=14), **moderate (n=93)** + high (n=58)

Subgroup Analysis

Continent
- 29% in North America (95% CI: 26-31%)
- 17% in Asia (95% CI: 12-23%)
- Significant subgroup differences (p < 0.01)

Outcome Measure
- Questionnaires: 29% (95% CI: 26-32%)
- Clinical diagnoses: 23% (95% CI: 0.20-0.26%)
- Significant subgroup differences (p < 0.01)

Meta-Regression

- **Age (-0.0027, 95% CI: -0.0039 to -0.0015, p = <0.001)**
- Year of publication (0.0033, 95% CI: -0.0001 to -0.0066, p = 0.0571)
- Gender balance (-0.0005, 95% CI: -0.0016 to -0.0005, p = 0.3324)
- % mild TBI (-0.0008, 95% CI: -0.0018 to 0.0002, p = 0.1066)
- % mod-severe (0.0009, 95% CI: -0.0001 to 0.0019, p = 0.0881)
- Quality of study (0.0049, 95% CI: -0.0046 0.0143, p = 0.3105)

Publication Bias and Sensitivity Analysis

- No evidence of publication bias **(p = 0.2913)**
- Outlier + influence analysis identified + removed 47 studies – prevalence reduced very slightly after **26.46%**
- Leave-1-out sensitivity analysis found **26.70**% (95% CI 0.2485; 0.2860)

Discussion

Moderators

1. Location of study: cultural factors, expression of symptoms, socio-economic reason, socio-political factors
2. Outcome measure: self-report measure sensitivity, perception of symptoms, guiding questions vs unstructured clinical questions
3. Age of participant: protective factors, emotional regulation, social networks, stability

Limitations

- High heterogeneity in findings
- Possible ppts held diagnoses of depression prior to TBI
- Unable to fully control for anti-depressants use
- Limited studies outside of western contexts

Clinical Implications

- Accurate allocation of funding, resources + training
- Integration of mental health services into rehabilitation programs
- Routine screening for high-risk groups
- Overall: prevent chronic conditions, speed recovery from TBI, save costs and reduce pressure

Future Research

- Review a combination of neuropsychiatric sequalae
- Further investigations into moderators
- Longitudinal studies to track post-TBI depression overtime
- More studies in non-westernised countries

Conclusion

- ✓ Examined large body of research (n = 165)
- ✓ Post-TBI depression has a high prevalence rate (27%)
- ✓ Sub-group analyses found deviations from this rate – higher prevalence in the USA and with self-report measures
- ✓ Meta-regression found age to be a small but significant moderator with increasing age leading to a decreased prevalence rate
- ✓ No publication bias + sensitivity analyses found minor differences (max 1%)

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