

The psychometric measures to assess aggressive dimension following traumatic brain injury

A review

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Abstract

Background: higher level of aggression and antisocial behavior are frequent following head trauma, due to specific brain alterations. Many tests are used to assess this aspect. A descriptive review was conducted on the main tests used to detect the appearance of aggressive dimensions following traumatic brain injury.

Review summary: we searched on PubMed and Web of Science databases and screening references of included studies and review articles for additional citations. From initial 723 publications, only 7 met our search criteria. Findings showed that various psychometric tools are used to assess aggressiveness and its subdomains, following head trauma.

Conclusions: further investigation are necessary to clarify whether these tools ensure a reliable diagnosis in order to make an early intervention and reduce violent behavior and its development.

Abbreviations: ABS = agitated behavior scale, BAAQ = brief anger and aggression questionnaire, NFI = neurobehavioral functioning inventory, NPI = neuropsychiatric inventory, OAS = overt aggression scale, TBI = traumatic brain injury.

Keywords: aggression evaluation, criminal behavior, psychometric measures, traumatic brain injury, violence

1. Introduction

The use of psychometric tests to detect the appearance of aggressive size following traumatic brain injury (TBI) has proven to be important.^[1] Detection of aggressive behavior can be the key to early intervention to improve patients' quality of life.^[2] Investigating all dimensions of aggressive behavior, such as frequency of attacks, size of aggression, and type (both verbal and physical), can be critical to better understand the correlation

between TBI and the development of violent behavior. Few studies have examined the long-term prevalence of aggression among individuals who have experienced a TBI or have illustrated the frequency or type of aggressive episodes.^[3–5]

There are specific scales capable of measuring these aspects, which are very important to establish appropriate outcomes. Cusimano et al^[6] examined the validity of scales used to assess aggression following TBI, underlining the scarcity of well-validated, population-specific measurement tools. Individuating a specific and valid scale for aggressiveness after TBI could be helpful to support rehabilitation and social reintegration strategies.

One type of scale used to examine the behavior of TBI patients who suffered hospitalization in a traumatic environment was the overt aggression scale (OAS)^[7] used by Baguley et al^[8] in a study on the aggressive behavior following TBI. The OAS measures both global aggressiveness and 4 specific subtypes of aggressiveness (verbal, physical towards objects, physical towards oneself and physical towards others). The scale has a high reliability; the scores can be summed into a single aggressiveness score, defined as the sum of the highest weighted score in each of the 4 scales, giving an interval from 0 to 21.

The use of instruments composed of several scales allows to study the construct of aggression in all its dimensions. A questionnaire that investigates the different dimensions of the construct is the Buss-Perry aggression.^[9] This 29-voice questionnaire has a score on a five-point scale. It includes a total aggressiveness scale and four sub-scales that assess the emotional (i.e. anger), cognitive (i.e. hostility) and behavioral (i.e. physical aggressiveness, verbal aggressiveness) components of aggression.

Generally, tools used in studies investigating aggressiveness, mainly refer to questionnaires or self-assessment scales, which try

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to show the appearance of the aggressive dimension after the trauma, evaluating the incidence of the triggering factors that may have contributed.

One of the factors that proved to be incidental in the development of the aggressive dimension after trauma was found in the severity of TBI. Any test that aims to investigate aggression after trauma should also take into account the severity of the trauma itself, which is determined by the Glasgow coma scale^[10] The Glasgow coma scale is the most widely used tool to quantify the severity of TBI.^[11]

The battery of tests administered must also include the extent of aggression, such as in the brief anger and aggression questionnaire,^[12] a brief measure developed for rapid screening and identification of levels of anger and aggression in men prone to violence.^[13] Given the epidemiological evidence of the relationship between TBI during childhood and adolescence and the onset of psychiatric disorders and crime, it is important to use scales that investigate the extent of aggression in young people.^[14] Studies have linked TBI in childhood and adolescence to higher rates of behavioral disorders and substance abuse, which are a risk factor for crime.^[15–17] Based on these findings, it becomes important to evaluate the history of TBI and current symptoms. After a childhood brain injury, impaired socio-emotional communication skills increase the risk of offensive behavior.^[5] Children and adolescents with TBI generally have difficulty understanding the social situations in which they find themselves,^[18] because, due to trauma, the areas considered responsible for emotional regulation are compromised, thus changing the balance of the systems responsible for the behavior.

This review aims to investigate which psychometric tools are the most widely used for the assessment of aggression after head trauma in order to help clinicians with an early and adequate diagnosis.

2. Methods

A descriptive review was conducted on the usefulness of psychometric tools used for the diagnosis of aggressive behavior in relation to TBI. In particular, we wanted to highlight the possible importance of these tools for an immediate diagnosis and timely intervention, taking into account the various dimensions of the “aggressiveness” construct and the factors related to it. The studies were identified through research on PubMed (2003, year of the first article published, year of publication of the first article–2018) and on the Web of Science database (2003–2018). The research combined the keyword, TBI with the terms: aggression, brain imaging, criminal behavior, violence, forensic psychiatry, juvenile delinquents, and psychiatric comorbidity. The terms of research have been identified as title and abstract. We selected only texts in English. After removing duplicates, all articles were evaluated by title, abstract and text. Search and selection of eligible articles can be identified in Figure 1. The ethical approval was not necessary because it was a descriptive review.

3. Results

Studies have found an importance in the use of these psychometric tools for an early diagnosis of the aggressive dimension after trauma. There are few scales that focus specifically on aggressiveness and its subcomponents (such as agitation and/or impulsiveness) after TBI (see Table 1). In 2006, Baguley^[8] demonstrated the relationship between the aggressive

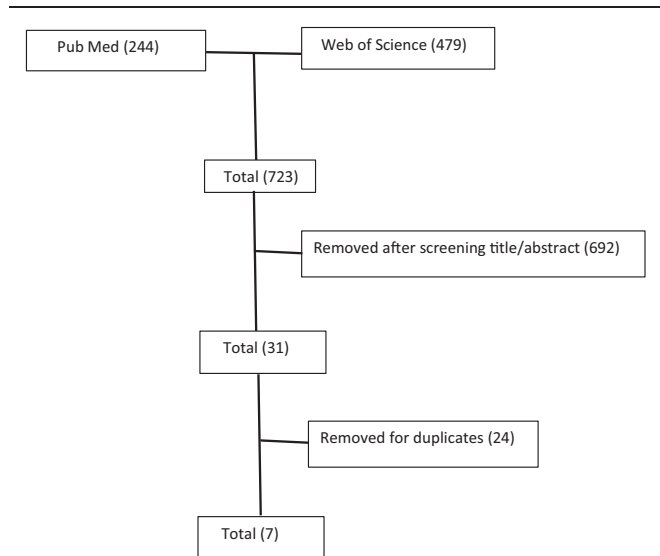


Figure 1. Search and selection of eligible articles.

dimension and the cranial trauma in an acute traumatic environment using the OAS.^[7] The OAS measures both overall aggressiveness and 4 specific subtypes of aggressiveness (verbal, physical towards objects, physical towards oneself and physical towards others). The main results of the study were that aggression rates are about 25% after TBI. The overall aggression level, the type of aggression, and the proportion of aggressive patients found among TBI survivors did not vary significantly over time, instead, the highest depression and the youngest age at the time of injury were the most significant predictors of aggression after TBI. Indeed, individuals who were younger at the time of injury or depressed after rehabilitation (6, 24 and 60 months after TBI) were more likely to become aggressive.

A history of TBI was linked to more violent crimes, as well as more diagnoses and mental health symptoms.^[19]

The presence of agitation symptoms in the early phase of recovery from TBI could be a predictor of further violent behavior during the rehabilitation.^[20] A validated observational scale that assess agitation symptoms is the agitated behavior scale, a 14-items questionnaire, scored by staff, that allows clinicians to investigate disinhibition, aggressiveness and lability.^[21]

Another common feature following TBI is impulsiveness, that might result in increased irritability and verbal or physical aggression^[22] with a strong negative impact on rehabilitation processes. There is still no valid tool specifically designed to assess impulsivity changes after TBI.^[23] In 2006, Dyer^[24] measured the impulsiveness dimension using the Barratt impulsiveness scale version 11.^[25] All participants were given each measure of the questionnaire individually with the corresponding written/verbal instructions for their completion. The battery of evaluations consisted of the above measures of social desirability, aggressiveness and impulsiveness. Each participant completed these measures under the supervision of the investigator. Consistent with previous studies, the nature of TBI aggressiveness was found to be largely impulsive. Impulsiveness was a strong predictor of overall aggression in the sample, representing 11.5% of the

Table 1**Studies assessing aggressive behavior.**

Author	Test measure	Variable examined	Level of data and description
Yudofsky (1986)	Over Aggression Scale (OAS)	Aggression	Ordinal: 4 subscales; 4 items each; weighted scores; subject administered
Buss, Perry (1992)	Buss-Perry Aggression Questionnaire (BPAQ)	Aggression in adults	29 items; 4 subscales; physical aggression (9 items); verbal aggression (5 items); anger (8 items); hostility (8 items)
Patton e Stanford (1995)	Baratt Impulsiveness Scale-Version 11 (BIS 11)	Impulsiveness	30-item scale scored on a four-point likert scale
Bryant & Smith (2001)	Brief Anger and Aggression Questionnaire (BAAQ)	Anger and Aggression	Brief sel-report measure;12-item; uses 4 3-item subscales: Physical Aggression, Verbal Aggression, Anger, and Hostility
Pennebaker & Susman (1988)	Childhood Trauma Questionnaire (CTQ)	Traumatic experiences (during childhood)	self-assessment; 28 items; allows to detect a total score and five partial scores, related to the following dimensions: Emotional Abuse; Physical Abuse; Sexual Abuse; Emotional Negligence; Physical Neglect.
Corrigan et al, 1989	The agitated Behavior Scale (ABS)	Disinhibition, aggressiveness, lability	Observational scale assessing agitation symptoms in early phase of recovery after TBI
Kreutzer et al, 1996	The neurobehavioral functioning inventory (NFI)	Depression, somatic, memory/attention, communication, aggression and motor.	Self-report questionnaire with a part for caregiver and another for the patient
Cummings et al, 1994	The Neuropsychiatric inventory (NPI)	Delusions, hallucinations, sleep disorders; agitation, irritability, aberrant motor behavior; depression, anxiety and apathy; euphoria and disinhibition; appetite and eating disorders	Semi-structured interview with a caregiver
Baker et al, 1998	Katz Adjustment Scale (KAS)	Antisocial component includes impulsivity and the verbal expansiveness component of aggression	Observer-rater questionnaire consisting in 10 subscale divided equally between subjects and caregivers

variance of self-aggression scores. Among the participants with TBI the correlation between these variables was substantial. The TBI group also had high levels of impulsiveness. According to Slaughter,^[13] further research is needed to assess the role of TBI sequelae of anger, aggression, impulsiveness and memory loss in initial and ongoing involvement in crime and the criminal justice system. In this study, 69 (75.8%) of the 91 individuals contacted agreed to participate in the study. The demographic composition of the sample was similar to that of the general prison population. Of the 69 participants, more than a third (25 subjects, the 36.2%) reported having had a TBI in the 12 months immediately preceding the interview. Of these, 20 (29.0%) reported a mild TBI and five (7.2%) reported a moderate/severe TBI during the previous year. Sixty (87.0%) of the study sample reported TBIs over a period of their lifetime, while 20 (29.0%) reported a history of moderate/severe TBIs over their lifetime. Subjects divided into two subgroups were given logical neuropsychological tests and diagnostic psychiatric interviews. The two groups differed significantly on brief anger and aggression questionnaire,^[12] with the group reporting a recent TBI that showed higher levels of anger and aggression.

3.1. Other Questionnaire assessing aggressiveness

The major part of scales used to assess aggressiveness following TBI are more general and include a wide range of neurobehavioral symptoms; classic examples are the neurobehavioral functioning inventory (NFI) or the neuropsychiatric inventory (NPI). The first is a brief self-report questionnaire administered by both the patient and the caregiver; aggression is only one of the

six subscales and its identified by nine items; other subscales include: depression (13 items), somatic (11 items) memory/ attentions (19 items), communication (10 items) and motor (8 items).^[26] Similarly the NPI is a scale, initially designed to measure behaviors observed in dementia patients, and after used to other neurological disorders such as TBI. Aggressiveness is investigated in the subscale assessing agitation, irritability and aberrant motor behavior.^[27] Finally, the Katz adjustment scale, is an observer-rater questionnaire that consists in 10 subscales divided equally between subjects and relatives. One subscale deepens antisocial behavior components, including impulsivity and verbal expansiveness, typical of aggression.^[28]

4. Discussion

The studies found a wide use of psychometric instruments used for the evaluation of the construct “aggressiveness” following the head injury. All scales have been validated in TBI population, and some of them demonstrated to have a good internal consistency with Cronbach’s alphas around 0.8 (NPI, OAS, agitated behavior scale, NFI).^[29] It is not yet clear, however, whether these tools guarantee a reliable diagnosis in order to carry out an early intervention and reduce violent behavior and its development. The tools used are not always the same, this may be at the discretion of the researcher, and therefore depend on the subjective dimension. NFI, NPI, and Katz adjustment scale could be considered as completed tools for TBI patients; on the other side, these scales are more general than other scales, such as OAS, that focuses specifically on aggressiveness and its subtypes.

However, it is important that an objective protocol is established on the tools to be used in order to collect data in a uniform way and evaluate their usefulness. Especially because head trauma is widespread at a young age and early diagnosis could be the key to functional intervention. Further investigation is needed to determine to what extent TBI during childhood or adolescence becomes a risk factor for a person to develop psychiatric disorders and engage in criminal activities.^[14] The implications of the current results highlight the importance of screening for TBI. However, screening for TBI after crime has started is not sufficient; stronger preventive action is needed. Given the clear evidence linking TBI to subsequent crime; it is imperative to identify TBI in at-risk young people, such as adolescents who use substances, or who exhibit antisocial behavior, and so on, and provide the right references for neuropsychology, evaluation, cognitive rehabilitation and other intervention services before neurobehavioral sequelae contribute to crime.^[19] It may be important and effective to identify and intervene in this process, with early identification of TBI and screening for psychiatric and behavioral problems in inmates with TBI, education of inmates and health professionals and early treatment of psychiatric and behavioral problems in inmates. Although only a few tests have been recommended for screening inmates for neuropsychological deficits in correctional care, other tools may be more suitable for screening individuals who may benefit from the intervention. In addition, the various test scores and prevalence trends of psychiatric disorder suggest that a history of TBI is potentially associated with poorer cognitive functioning and increased rates of psychiatric disorders.^[13] The relation between TBI and offending behavior is consistent with previous research. It has been estimated that 48% to 82% of individuals in the prison system have a history of TBI.^[30] One of the factors that can be assessed in subsequent studies may be the emotional experience related to possible trauma suffered in childhood and beyond, which may have influenced cognitive degeneration causing deviant personality traits related to crime. Measures of children's adversity (e.g., physical abuse, physical abandonment, sexual abuse, emotional abuse, emotional abandonment) could be assessed through the childhood trauma questionnaire^[31] which demonstrated internal consistency, convergent and discriminating validity, good sensitivity and satisfactory levels of specificity.^[16] Future research in any case should include the continuous refinement of the investigation of TBI's association with crime and recidivism, perhaps through a prospective study and more extensive and accurate neuropsychological tests, in order to build a precise procedure for accurate diagnosis and effective intervention.

Author contributions

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