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# Post-Traumatic Stress Disorder Among Patients Surviving Road Traffic Accidents: Psychological Evaluation, Nursing Interventions, Laboratory Assessment, and Social Reintegration.

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## Abstract

**Background:** Road traffic accidents (RTAs) are major traumatic events that can lead to persistent psychological consequences, particularly post-traumatic stress disorder (PTSD). PTSD may affect accident survivors regardless of injury severity and can interfere with their psychological well-being, social relationships, and occupational functioning.

**Aim:** This review examines the prevalence, persistence, risk factors, cognitive mechanisms, comorbidities, consequences, assessment methods, and treatment approaches associated with PTSD following RTAs.

**Methods:** Relevant studies investigating PTSD among RTA survivors were reviewed. The included literature covered different geographical regions, populations, study designs, diagnostic approaches, assessment instruments, and therapeutic interventions. Study characteristics and methodological quality were also examined using the LEGEND evidence-assessment framework.

**Results:** PTSD prevalence varied considerably across studies, reflecting differences in diagnostic criteria, assessment instruments, populations, and follow-up periods. Symptoms could persist for several years, although remission occurred in a proportion of affected individuals. Reported risk factors included previous psychiatric disorders, perceived threat, pain, psychological distress, and socioeconomic difficulties. Cognitive mechanisms, including rumination, thought suppression, and maladaptive metacognitive beliefs, were associated with symptom development and persistence. PTSD frequently coexisted with depression, anxiety, acute stress symptoms, and cognitive difficulties. Its consequences extended to impaired quality of life, reduced occupational functioning, and social limitations. Cognitive behavioral therapy, exposure-based interventions, and virtual reality approaches represented important treatment strategies.

**Conclusion:** PTSD is a significant consequence of RTAs that requires early recognition, appropriate assessment, and access to evidence-based psychological interventions. Further research should address geographical gaps and identify effective approaches for preventing chronic symptoms.

**Keywords:** Road traffic accidents; post-traumatic stress disorder; psychological trauma; risk factors; cognitive behavioral therapy; quality of life.

## Introduction

Exposure to potentially traumatic events (PTEs) is common throughout life and may result in acute psychological reactions, including severe anxiety, dissociation, sleep disturbances, and emotional distress. Although not all individuals exposed to trauma develop post-traumatic stress disorder (PTSD), psychological symptoms may persist, intensify, and interfere with daily functioning over time [1]. PTSD is classified in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), as a trauma- and stressor-related disorder that develops following exposure to actual or threatened death, serious injury, or sexual violence


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[1]. Its clinical presentation involves four principal symptom domains: intrusive memories and re-experiencing, avoidance of trauma-related stimuli, negative alterations in cognition and mood, and heightened arousal or reactivity [2]. The development and progression of PTSD are influenced by individual vulnerability, trauma characteristics, and the social and environmental circumstances surrounding the event. Repeated or prolonged exposure may further complicate psychological recovery [3,4]. Road traffic accidents (RTAs) represent a major source of traumatic exposure worldwide and are associated with substantial physical, psychological, and socioeconomic consequences. Beyond physical injuries, survivors may experience persistent fear, intrusive recollections, avoidance behaviours, and difficulties returning to routine activities. PTSD prevalence following RTAs has been estimated at approximately 20%–45% during the initial weeks after an accident, with symptoms persisting in a considerable proportion of affected individuals for up to three years [5–7]. These outcomes highlight the need to consider psychological recovery alongside physical rehabilitation. Nevertheless, the psychological consequences of RTAs remain insufficiently represented in trauma research, particularly in low- and middle-income countries, where healthcare resources and access to specialized mental health services may be limited [2,8].

Previous systematic reviews have examined different aspects of PTSD following traumatic events and RTAs. However, important gaps remain in understanding the full clinical and psychosocial burden among accident survivors. Lin et al. [9] primarily investigated prevalence, providing limited consideration of factors associated with symptom severity and long-term recovery. Ponniah and Hollon [10] examined PTSD treatment approaches more broadly but did not specifically address RTA survivor populations or their post-accident quality of life. Similarly, Boccia et al. [11] focused on hospital-based Eye Movement Desensitization and Reprocessing (EMDR), highlighting the need for further investigation of outpatient populations and individuals with less severe physical injuries. Geographical representation is another limitation in the existing literature. Studies from low- and middle-income countries remain underrepresented in global evidence syntheses despite the substantial burden of road traffic injuries in these settings [12,13]. Southeastern European countries, including North Macedonia, Serbia, Bosnia and Herzegovina, Croatia, and Bulgaria, also experience road traffic fatality rates exceeding the European Union average, reflecting continuing road safety challenges [14]. Including evidence from these and other underrepresented regions can improve the geographical relevance of findings and provide a broader understanding of differences in trauma exposure, psychological outcomes, and access to treatment. This systematic review therefore examines PTSD among adult RTA survivors through a narrative thematic synthesis of the available literature. It considers prevalence, symptom severity, associated predictors, psychiatric comorbidities, and treatment approaches. Particular attention is given to individuals with minor physical injuries and populations from underrepresented regions.

**Study Characteristics:**

The included studies covered a broad range of publication years, geographical settings, research designs, and methodological approaches. Publication dates extended from 1989 to 2024, reflecting the development of research on post-traumatic stress disorder (PTSD) following road traffic accidents (RTAs). The evidence originated from North America, Europe, Asia, Africa, and the Middle East. Frequently represented countries included the United States, United Kingdom, Germany, France, Australia, Iran, and Israel. Studies from Nigeria, Ethiopia, Benin, Tunisia, Croatia, and Romania also contributed to the geographical diversity of the evidence base. This representation allowed the review to consider findings from regions with different road safety conditions, healthcare resources, and access to psychological services [12,13,21,29,55,56,75,80]. Quantitative research was the predominant methodological approach. The included studies employed cross-sectional, prospective, longitudinal, cohort, case-control, experimental, and survey designs. Cross-sectional investigations mainly examined PTSD prevalence, associated risk factors, psychological symptoms, and sociodemographic characteristics. Prospective and longitudinal studies provided information about the development, persistence, and remission of PTSD following RTAs. Several investigations evaluated psychological outcomes at different follow-up intervals, including six weeks, six months, one year, and up to seven years after the accident [5,7,19,32,45,62,67,102]. Other studies explored predictors of PTSD, including acute stress reactions, injury severity, traumatic memories, unconsciousness, depression, amnesia, and social support [40,63,68,73,78,82,85].

Psychometric research constituted another important component of the literature. These studies examined the reliability, validity, and clinical applicability of instruments used to assess PTSD, anxiety, emotional distress, coping mechanisms, and functional impairment. Assessment tools included the Accident Fear Questionnaire, Trauma Symptom Inventory, Davidson Trauma Scale, and measures of psychological distress and disability [20,31,38,47,50]. These investigations supported the evaluation of psychological outcomes across different populations and clinical settings. Interventional

studies examined several approaches to PTSD treatment and recovery. These included cognitive behavioral therapy (CBT), Eye Movement Desensitization and Reprocessing (EMDR), virtual reality exposure therapy, memory-focused interventions, expressive writing, and art therapy. Randomized controlled trials and experimental investigations provided evidence concerning the effectiveness of these approaches and the psychological mechanisms involved [11,25,41,53,60,61,66,74,89,99–101]. Additional research investigated neurobiological and physiological aspects of PTSD through functional magnetic resonance imaging, brain structure assessment, and heart rate responses [87,90,97,98].

The LEGEND assessment demonstrated variation in the methodological quality of the included evidence [17]. Most studies received ratings of 3B, 3A, 4A, or 4B, indicating a substantial contribution from observational, cross-sectional, psychometric, and experimental research. Higher-level evidence included the meta-analysis by Boccia et al. [11], rated 1B, and several randomized controlled trials and systematic evidence reviews rated 2A or 2B [25,41,53,66,69,72,89,96,100,101]. Some studies received lower ratings, including the psychophysiological investigation by Veazey et al. [98], rated 5A. Overall, the included literature addressed PTSD prevalence, severity, predictors, comorbidities, functional consequences, and treatment following RTAs. Nevertheless, differences in study design, assessment instruments, follow-up periods, geographical representation, and methodological quality should be considered when interpreting and comparing the findings.

**PTSD Symptom Prevalence and Persistence**

Post-traumatic stress disorder (PTSD) is a frequent psychological consequence of road traffic accidents (RTAs), with prevalence estimates varying according to diagnostic criteria, assessment instruments, population characteristics, and the time elapsed since the accident. Studies indicate that approximately one-fifth to nearly half of RTA survivors may meet the diagnostic criteria for PTSD during the early post-accident period. In a study involving 69 survivors aged 18–65 years, six-week PTSD prevalence was 20% according to the Diagnostic and Statistical Manual criteria and 46% according to the International Classification of Diseases, 10th Revision (ICD-10) criteria [5]. Similarly, a prevalence of 45.2% was reported during the first year following an RTA among 274 participants [6]. These findings demonstrate the substantial psychological burden associated with road accidents and highlight the influence of diagnostic classification on reported prevalence. Evidence from larger populations supports these observations. Among 5,807 individuals assessed one month after an RTA, approximately 40% experienced PTSD symptoms, including 28.6% with mild symptoms and 11.6% with severe symptoms [95]. Another study involving 155 survivors, with a median age of 42 years and a male representation of 54.8%, reported PTSD in 32.3% of participants. Depression and anxiety were also identified in 17.4% and 5.8%, respectively [75]. These findings suggest that psychological consequences following RTAs frequently extend beyond PTSD and may involve overlapping emotional disorders. Comparative studies have further demonstrated the increased psychological vulnerability of accident survivors. PTSD prevalence reached 41% among RTA survivors compared with 13% in control participants. Depression was also more frequent among survivors, affecting 63% compared with 34% of controls [21,38]. Although prevalence may decline over time, clinically significant symptoms can persist beyond the initial recovery period. Approximately 18% of 592 individuals continued to experience PTSD six months after an accident [45]. Another longitudinal investigation reported prevalence rates of 29.8%, 23.1%, and 17.9% at 3, 6, and 12 months, respectively, among 95 participants [102].

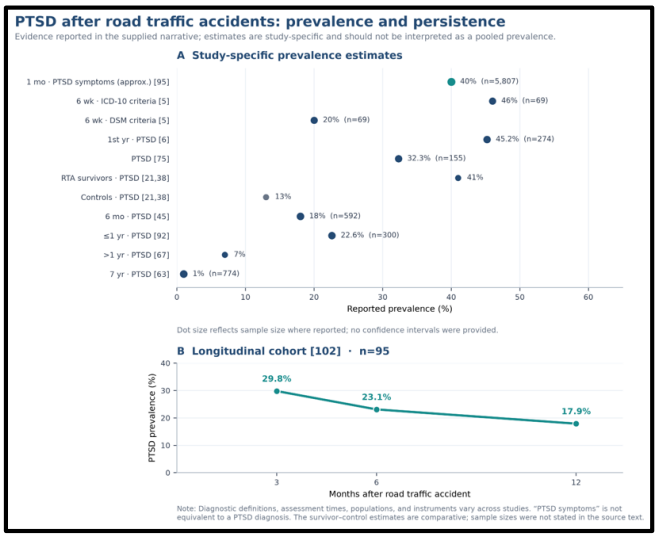



**Figure-1:** Prevalence of PSTD after Road Traffic Accidents.

Importantly, psychological morbidity is not restricted to individuals involved in severe collisions. Even minor RTAs may produce clinically significant psychological distress, indicating that the apparent physical severity of an accident does not reliably predict its psychological consequences [20,142]. Time elapsed since the accident, depressive symptoms, previous RTA exposure, and the presence of common mental disorders have also been identified as significant determinants of PTSD development [29]. These factors support the need for psychological assessment based on individual risk rather than injury severity alone. Although PTSD prevalence generally decreases during follow-up, a proportion of RTA survivors experience prolonged symptoms. A study involving 300 participants

reported a PTSD prevalence of 22.6% within one year of the accident [92]. Longer-term observations indicate that approximately 7% of survivors continued to meet the diagnostic criteria for PTSD after one year, while another 9% experienced subsyndromal post-traumatic stress symptoms [67]. These findings demonstrate that recovery does not occur uniformly and that clinically relevant psychological difficulties may remain even when the full diagnostic threshold is no longer met. Longitudinal evidence also indicates that PTSD can persist for several years. More than half of individuals initially diagnosed with PTSD continued to experience the disorder three years after the accident [8,63]. Nevertheless, long-term prevalence may become substantially lower. Seven years after an RTA, only eight of 774 participants (1.0%) met the diagnostic criteria for PTSD [63]. This reduction suggests that spontaneous recovery occurs in some survivors, although persistent cases may require prolonged clinical support. Remission is also possible within the first year. In one study, 77% of 48 individuals who initially met the diagnostic criteria no longer fulfilled them after one year of follow-up [32]. Overall, these findings indicate that PTSD following RTAs has a variable course, ranging from early remission to persistent symptoms lasting several years. Repeated assessment may therefore help identify individuals who require psychological intervention during recovery.

**Risk Factors for Developing PTSD Post-RTA**

Physical injuries sustained during road traffic accidents (RTAs) may contribute to the development and severity of post-traumatic stress disorder (PTSD). However, the strength of this association varies across studies. A longitudinal investigation demonstrated a significant positive correlation between self-rated injury severity and PTSD symptom severity at four weeks ($r = 0.25$, $p < 0.01$) and six months ($r = 0.21$, $p < 0.05$) after the accident [85]. Similarly, injury type and severity were identified as the leading risk factors for PTSD development in a cross-sectional study, with a significant association ($p = 0.013$) and an overall PTSD prevalence of 54.2% among 120 participants [83]. The relationship between severe physical trauma and psychological morbidity is also supported by findings from a longitudinal study involving 1,260 RTA survivors. Participants who experienced loss of consciousness (22.8%) or major injuries (9.5%) were more likely to develop PTSD, depression, and anxiety than those without these injury characteristics [93]. Nevertheless, the association is not consistent across all investigations. One longitudinal study found no significant difference in PTSD development between individuals who experienced unconsciousness and those who remained conscious one year after the accident [82]. Another cross-sectional study reported no significant relationship between physical injury severity and PTSD symptom severity [24]. These differences may reflect variations in assessment methods, follow-up periods, injury classifications, and individual psychological responses. Beyond injury severity, post-accident pain and prolonged hospitalisation may contribute to psychological distress. Both factors were significantly associated with PTSD in one study, with $p$ values of 0.006 and 0.011, respectively [75].

Pre-existing psychological vulnerability and subjective perceptions of the accident are important determinants of PTSD. Cross-sectional evidence has identified perceived threat to life ($p = 0.002$), previous psychiatric illness ($p = 0.008$), and psychiatric medication use ($p < 0.001$) as significant risk factors [76]. These findings suggest that psychological history and the individual's interpretation of the traumatic event may influence subsequent symptom development. Gender and marital status have also been associated with differences in symptom severity. One study reported higher PTSD severity among females than males ($p < 0.05$) and among married individuals compared with single participants ($p < 0.001$) [79]. Conversely, certain psychological responses may support recovery. Forgiveness of the individual responsible for the accident was associated with reduced PTSD severity ($\beta = -0.21$, $t = -3.50$, $p < 0.001$) [64]. This finding suggests that emotional processing and interpersonal responses may influence post-traumatic adjustment. Importantly, survivors with minor physical injuries should not be considered psychologically protected. Although their injuries may appear limited, they can still experience substantial distress. Further longitudinal research is needed to clarify the persistence and functional consequences of PTSD in this population. Sociodemographic characteristics and socioeconomic circumstances may influence vulnerability to PTSD following RTAs. Female gender ($p = 0.038$), below-average perceived economic status ($p = 0.025$), and general medication use ($p = 0.002$) were significantly associated with PTSD in a cross-sectional study [75]. Accident-related circumstances also appeared relevant. Participants who were not responsible for the accident ($p = 0.044$) and those who had submitted compensation claims ($p < 0.001$) demonstrated significant associations with PTSD [75]. These findings may reflect the influence of perceived injustice, financial concerns, and prolonged accident-related disputes on psychological recovery.

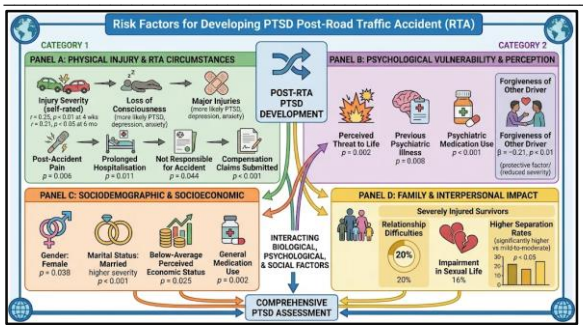



**Figure-2:** Risk Factors for PSTD after road traffic accidents.

The consequences of severe injuries may also extend to family and interpersonal relationships. In a longitudinal study, 20% of severely injured participants reported relationship difficulties with their partners, while 16% experienced impairment in their sexual lives. Separation rates were also significantly higher among individuals with severe injuries than among those with mild-to-moderate injuries [64]. Collectively, these findings indicate that PTSD risk is influenced by interacting biological, psychological, and social factors. A comprehensive assessment should therefore consider injury characteristics, previous psychiatric history, perceived threat, socioeconomic circumstances, and relationship difficulties rather than relying exclusively on physical injury severity.

**Cognitive Mechanisms Associated with PTSD After an RTA**

Cognitive processes play an important role in the development and persistence of post-traumatic stress disorder (PTSD) following road traffic accidents (RTAs). Difficulties in processing traumatic memories, regulating intrusive thoughts, and controlling emotional responses may contribute to symptom severity and interfere with psychological recovery. Several cognitive mechanisms have been associated with post-RTA PTSD, including rumination, thought suppression, impaired working memory, maladaptive metacognitive beliefs, and ineffective coping strategies. Understanding these mechanisms may help identify individuals at risk of persistent symptoms and inform psychological interventions. Rumination is a key cognitive process associated with trauma-related distress. It involves repetitive attention to traumatic experiences, their consequences, and associated negative emotions. Studies of RTA survivors have identified recurrent and involuntary trauma-related thinking among individuals experiencing PTSD symptoms [28,51,80,93,122]. Although individuals may attempt to control distressing memories through deliberate thought suppression, this strategy can have counterproductive effects. Suppressing thoughts about an RTA has been associated with an increase in trauma-related intrusions, including among individuals who do not meet the diagnostic criteria for PTSD [27]. These findings suggest that persistent rumination and attempts to avoid unwanted thoughts may reinforce the accessibility of traumatic memories and increase psychological distress. Working memory and cognitive control are also relevant to post-traumatic symptoms. Working memory enables individuals to maintain and manipulate information while performing cognitive tasks. However, trauma-related intrusions and avoidance may interfere with these processes. An indirect association has been reported between PTSD diagnosis and working memory capacity under emotionally demanding conditions, with re-experiencing symptoms and avoidance behaviors acting as mediating factors [49]. Furthermore, individuals with PTSD may experience impaired proactive interference control, in which previously acquired information disrupts the retrieval of newer memories [120]. Such difficulties may reduce the ability to process new information and distinguish current safe situations from reminders of the traumatic event.

Metacognitive beliefs, which refer to individuals' perceptions and interpretations of their own thinking processes, may further contribute to symptom maintenance. PTSD severity has been positively correlated with beliefs that worry is beneficial or necessary ($r = 0.25$, $p = 0.006$), beliefs concerning the need to control thoughts ($r = 0.50$, $p < 0.0005$), and negative beliefs about the danger of certain thoughts ($r = 0.60$, $p < 0.01$) [94]. Individuals who interpret intrusive memories as dangerous or uncontrollable may become increasingly distressed by their occurrence, reinforcing cycles of worry, monitoring, and avoidance. The pattern of PTSD symptoms may also vary during the early post-accident period. Six weeks after an RTA, 74 ± 4% of participants met the criteria for re-experiencing symptoms, compared with 38 ± 5% for avoidance and emotional numbing among 45 individuals [86]. This difference suggests that intrusive memories and related symptoms may be more prominent during early recovery, whereas avoidance-related responses may be less apparent at this stage. Finally, trauma exposure may affect coping capacity and interpersonal functioning. Individuals exposed to traumatic events, including RTAs and physical assault, have reported reduced individual and dyadic coping compared with non-traumatized controls [76]. These difficulties may limit emotional regulation, problem-solving, and the ability to manage relationship-related stress. Impaired coping may therefore contribute to continuing psychological distress and reduced interpersonal functioning [44]. Collectively, these cognitive and behavioral mechanisms demonstrate that post-RTA PTSD involves more than the recollection of a traumatic event. It may also disrupt memory processing, thought regulation, and everyday coping.

**Quality of Life and PTSD**

Post-traumatic stress disorder (PTSD) following road traffic accidents (RTAs) can affect

several dimensions of quality of life, including physical health, psychological well-being, social relationships, and environmental conditions. Lower scores across all four domains of the WHOQOL-BREF questionnaire were significantly associated with PTSD among RTA survivors [125]. One study reported negative associations between PTSD and physical health (B = −2.05, SD = 0.28, $p < 0.0001$), psychological health (B = −2.28, SD = 0.31, $p < 0.0001$), social relationships (B = −1.76, SD = 0.42, $p < 0.0001$), and environmental health (B = −1.83, SD = 0.30, $p < 0.001$). Age and financial difficulties were also associated with poorer quality-of-life outcomes, particularly in the physical and environmental domains [72]. The consequences of PTSD may extend to cognitive functioning and occupational performance. Individuals with PTSD demonstrated poorer memory flexibility than trauma-exposed and community control participants [89]. Financial consequences were also reported, with 32.6% of 555 RTA survivors experiencing PTSD alongside negative effects on monthly income [11]. Compared with individuals without PTSD, affected survivors reported poorer time management and greater preoccupation with health [81]. Furthermore, 70.2% experienced substantial impairment in work or education, while 51.9% reported difficulties in social life [55]. These findings demonstrate that PTSD can interfere with daily functioning, financial stability, and interpersonal relationships, emphasizing the need for interventions that address psychological symptoms and their broader consequences.

**Post-Traumatic Growth After an RTA**

Post-traumatic growth (PTG) refers to positive psychological changes that may emerge following exposure to traumatic experiences. The relationship between PTSD and PTG after RTAs remains complex. One study found no significant overall association between PTSD and PTG [22]. Nevertheless, experiencing PTSD does not necessarily prevent individuals from developing positive changes in psychological self-perception, well-being, and optimism. Married and more highly educated RTA survivors were more likely to report greater post-traumatic growth [112]. In contrast, age, gender, and the time elapsed since the accident were not significantly associated with PTG [124]. Associations have also been identified between PTSD and specific dimensions of post-traumatic growth. PTSD symptoms were negatively correlated with personal strength (r = −0.20, $p < 0.05$) but positively correlated with appreciation of life (r = 0.28, $p < 0.01$) and spiritual change (r = 0.20, $p < 0.05$) [103]. Additionally, individuals diagnosed with PTSD reported higher extrinsic motivation scores than those without PTSD (4.17 ± 1.53 versus 2.42 ± 1.21) [81]. Among survivors with severe PTSD symptoms, greater optimism was associated with higher levels of reported growth [103]. Social support may also contribute to this process, particularly among individuals who sustained major injuries and received greater support than those with minor injuries. Therefore, PTG may develop alongside psychological distress, although its expression depends on individual characteristics and available social resources [103].

**Comorbid Psychological and Cognitive Factors Associated with PTSD Post-RTA**

Post-traumatic stress disorder (PTSD) following road traffic accidents (RTAs) frequently co-occurs with psychological and cognitive conditions, including depression, acute stress disorder (ASD), anxiety, and traumatic brain injury (TBI). These conditions may influence symptom severity, complicate diagnosis, and affect recovery. PTSD following RTAs is significantly associated with current depression ($\chi^2 = 53.25$, $p < 0.001$) and duration of amnesia (KW = 6.23, $p = 0.01$) [73]. ASD is also an important predictor of subsequent PTSD severity. Approximately one-fifth of RTA survivors experience acute stress symptoms, including mood disturbances and intrusive memories [68,78,102]. One study reported ASD in 41.1% of participants, with lower perceived social support (OR = 0.0908, 95% CI = 0.834–0.989, $p = 0.027$) and greater peri-traumatic dissociation (OR = 1.332, 95% CI = 1.170–1.516, $p < 0.001$) associated with increased risk [102]. Although anxiety and depressive symptoms generally improve over time, approximately 10% of survivors continue to experience mood disorders one year after an accident [84,143]. Peri-traumatic distress also correlates significantly with PTSD assessment scores, including the IES-R, PTSD Checklist, and CAPS [19,108,144]. TBI may alter the presentation of acute stress and PTSD symptoms. Six days after an RTA, individuals with TBI demonstrated reduced recall of fear during the accident, increased dissociative symptoms, and fewer intrusive thoughts and images than those without TBI [68]. At six weeks, they also reported fewer re-experiencing and fear-related symptoms. Furthermore, ASD, chronic PTSD, and TBI have been associated with distinct patterns of disorganized accident-related narrative memory [43,69]. Psychological comorbidity is significantly associated with PTSD following RTAs (adjusted OR = 2.29, 95% CI: 1.28–4, $p < 0.05$) [13,18]. Additional manifestations include anxiety after minor accidents [57], hyperarousal [65], and self-blame following fatal accidents [79]. Depressive symptoms may also impair immediate verbal recall ($r = -0.56$), delayed recall ($r = -0.38$), and delayed recognition ($r = -0.55$) [23]. PTSD has additionally been associated with sadness, reduced self-esteem, impaired resilience, and negative post-traumatic cognitions among female survivors [42,70]. These findings support comprehensive psychological and cognitive assessment when evaluating RTA survivors.

**Treatments for PTSD**

**Cognitive Behavioral Therapy for PTSD Post-RTA**

Cognitive behavioral therapy (CBT) is among the most frequently investigated psychological interventions for post-traumatic stress disorder (PTSD) following road traffic accidents (RTAs). Randomized and non-randomized studies have demonstrated improvements in PTSD symptoms and psychological well-being following different CBT approaches [10,53,54,66,96]. In one comparative study, 30 participants receiving CBT showed greater reductions in Clinician-Administered PTSD Scale (CAPS) scores than 27 participants attending a support group and 22 individuals on a waiting list [33,109]. A 12-week CBT programme also reduced anxiety sensitivity and pain severity among RTA survivors [54]. Long-term follow-up of 100 patients found no significant difference in PTSD severity between brief exposure (10 minutes) and prolonged exposure (40 minutes) to traumatic memories after treatment, with improvements assessed over two years [41]. Furthermore, a four-week brief CBT intervention produced greater improvements in depression and hyperarousal symptoms than a self-help booklet programme [113]. Regarding treatment preferences, approximately three-quarters of 269 RTA survivors preferred face-to-face psychological care, while fewer than 10% preferred alternative formats, such as internet-based treatment [36].

**Virtual Reality Treatment for PTSD Post-RTA**

Virtual reality (VR) interventions provide controlled exposure to trauma-related situations and may help reduce avoidance and fear responses. Studies have reported improvements in re-experiencing, avoidance, and emotional numbing following VR-based interventions [25,27,99]. In survivors experiencing driving phobia, virtual driving environments combined with CBT were associated with reductions in distress, PTSD symptoms, depressive symptoms, and physiological arousal. A 12-session programme incorporating driving simulations also improved travel distress, travel avoidance, and maladaptive driving strategies [99]. Another investigation found lower clinical severity, PTSD symptom scores, overall event-related distress, and functional disability among participants receiving virtual reality exposure therapy (VRET) than controls. These differences were statistically significant across several assessment measures, including the Clinical Global Impression-Severity scale ($F$ = 12.76, $p$ = 0.001) and PTSD Checklist-Civilian version ($F$ = 11.87, $p$ = 0.002) [74]. These findings support further investigation of VR as an adjunct to conventional psychological treatment.

**Other Treatments of PTSD Post-RTA**

Other interventions have also been investigated, although their evidence remains variable. A pilot randomized trial found that Memory Structured Intervention reduced total PTSD symptoms, intrusive memories, and arousal symptoms following treatment [60]. Experimental research suggested that combining positive emotional stimulation with a cognitive dual task could reduce the distress associated with traumatic memories, although memory vividness remained unchanged [120]. In contrast, expressive writing shortly after trauma was associated with increased anxiety compared with a non-recall task [61]. Although survivors reported appreciating counselling, this approach did not consistently prevent psychological disorders [39]. Imaginal exposure, involving the mental reconstruction of feared situations, produced greater PTSD symptom reductions than supportive counselling at treatment completion and six-month follow-up [41]. Finally, an arts-based programme involving writing and drawing improved over time, but outcomes did not differ significantly from the control group [100]. Overall, exposure-based CBT approaches currently have the strongest support among the interventions discussed.

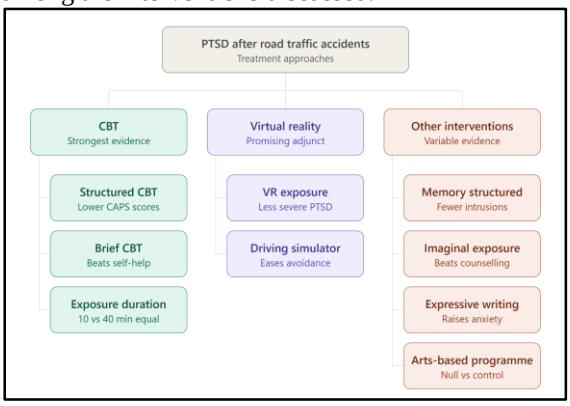



**Figure-3:** Treatment of PSTD After road traffic accidents.

**The Consequences of PTSD**

PTSD following road traffic accidents (RTAs) can produce physiological, neurological, and occupational consequences. Differences in resting heart rate and heart rate reactivity during stressful situations have been reported between individuals with chronic PTSD, subsyndromal PTSD, and those without PTSD [31,35,90,91,98]. Treatment may influence these physiological responses. One study reported a greater reduction in heart rate reactivity following cognitive behavioral therapy (CBT) than supportive psychotherapy [33]. However, no significant association between heart rate reactivity, gender, and post-RTA PTSD was identified in another investigation [37]. Neurological findings suggest that PTSD may also be associated with alterations in brain structure and function. Psychophysiological responses appeared to decrease at one-year follow-up compared with assessments conducted one to four months after the accident [34]. Individuals with PTSD demonstrated lower fractional anisotropy in the corpus callosum than trauma-exposed individuals without PTSD (0.58 ± 0.04

versus 0.61 ± 0.03, $p = 0.042$), suggesting differences in white matter integrity [97]. Increased functional connectivity between the amygdala and somatosensory regions during trauma-related stimulation has also been reported, alongside activation of the right anterior cingulate cortex in individuals with PTSD [11,87].

Employment is another important outcome. Injury severity influences return-to-work duration, with 32% of individuals with severe injuries remaining unemployed one year after the accident [58,64]. PTSD may impair occupational performance, while work and social limitations can predict persistent symptoms [26,102]. Poor quality of life and health status three years after an RTA have also been associated with failure to return to work [90]. Gender, however, was not significantly associated with changes in employment status [48]. Several instruments have been used to assess PTSD and related psychological conditions among RTA survivors. The Chinese version of the PTSD Checklist demonstrated satisfactory reliability and validity [50,102]. The Depression Anxiety Stress Scales-21 and Impact of Event Scale-Revised also showed acceptable diagnostic performance for detecting depression and PTSD in injured populations involved in compensation claims [62]. The PTSD PK and PS scales assess general emotional distress and maladjustment but have limitations in accurately classifying PTSD [49,52,114]. Similarly, the 35-item Glover Numbing Scale demonstrated poor suitability for assessing RTA survivors [46,47,146]. Assessment accuracy may also be affected by symptom exaggeration, as approximately 25% of participants were able to simulate psychological injury symptoms during evaluations [147]. Therefore, selecting validated instruments and interpreting results alongside clinical assessments remain important.

**Conclusion:**

PTSD represents a significant psychological consequence of road traffic accidents, with symptoms that may persist and impair survivors' quality of life, occupational performance, and social functioning. Its development involves multiple interacting factors, including previous psychiatric conditions, injury-related experiences, perceived threat, psychological distress, and cognitive processes. Depression, anxiety, acute stress symptoms, and cognitive difficulties may further complicate clinical presentation and recovery. Assessment requires appropriate diagnostic criteria and validated instruments to identify affected individuals and monitor symptom progression. Cognitive behavioral therapy, exposure-based interventions, and virtual reality approaches provide important treatment options, although treatment selection should reflect individual clinical needs. Early screening and access to psychological care should therefore form part of post-accident management. Future research should improve the representation of under investigated populations, particularly in low- and middle-income countries, and examine long-term outcomes, treatment effectiveness, and factors associated with recovery. These efforts may support more accessible and integrated psychological services for RTA survivors.

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