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Strangulation as an acquired brain injury in intimate-partner violence and its relationship to cognitive and psychological functioning: A preliminary study

Eve M. Valera[1,2], **Julia C. Daugherty**[3], **Olivia Scott**[4], **Howard Berenbaum**[5]

[1]Harvard Medical School, Boston, MA, USA

[2]Department of Psychiatry, Massachusetts General Hospital, Boston, MA, USA

[3]Mind, Brain Behavior Research Center (CIMCYC), Universidad de Granada, Granada, Spain, Campus Cartuja, Calle S/N, Granada, Granada, Spain 18010

[4]Harvard College, Cambridge, MA, USA

[5]Department of Psychology, University of Illinois at Urbana-Champaign

Abstract

Objective: The aim of this work was to examine the relationship between strangulation related alterations in consciousness (AIC) and cognitive and psychological outcomes in women who have experienced intimate-partner violence (IPV).

Setting: Participants were recruited from a variety of settings, including women's shelters and support programs.

Participants: A total of 99 women were enrolled in the study. After applying exclusion criteria for factors that could mask or confound the effects of strangulation, 52 women remained for analyses.

Design: Cross-sectional, retrospective.

Main Measures: We used several cognitive measures to assess learning, long-term and working memory, visuomotor speed, cognitive flexibility, and nonverbal cognitive fluency as well as several psychological measures to assess post-traumatic stress symptomatology, general distress, worry, anhedonic depression and anxious arousal. We also used the Brain Injury Severity Assessment interview to examine the association between strangulation-related AICs and these measures of cognitive and psychological functioning.

Results: Women who had experienced strangulation-related AICs performed more poorly on a test of long-term memory ($p<.03$) and had higher levels of depression ($p<.03$) and post-traumatic stress symptomatology ($p<.02$) than women who had not experienced strangulation-related AIC. When controlling for potential confounding variables, including number of IPV-related traumatic

Address correspondence to: Eve M Valera, PhD, Massachusetts General Hospital, Psychiatry, Rm 2660, 149 Thirteenth Street, Charlestown, MA 02129, Eve_valera@hms.harvard.edu, Phone: 617-724-0307, Fax: 617-726-4078.

brain injuries, women who had experienced strangulation also performed more poorly on a measure of working memory.

Conclusion: This is the first report to assess strangulation in this manner and demonstrate links to cognitive and psychological functioning. These preliminary data contribute to our knowledge of strangulation and its effects on women who have experienced IPV.

Introduction

Strangulation can be defined as the "sustained impairment of air or blood flow through the neck as a result of external pressure."[1] *Blood* may be restricted from leaving the brain by compression of the jugular veins or restricted from entering the brain by compression of the carotid arteries. *Air* may be restricted by compression of the trachea. Consequentially, strangulation may cause acquired brain injuries via at least two mechanisms. A hypoxic-ischemic brain injury may occur from lack of oxygen or nutrients to brain cells via compression of the carotids or trachea. Other damage to the brain may occur due to increased intracranial pressure when venous blood is not permitted to drain due to compression of the jugulars. Although not nearly as common, strangulation can also cause a range of other injuries (e.g., carotid dissection, swelling) long past the time of the attack. It can result in permanent injury or death within minutes while leaving no external marks on the victim.[2]

Strangulation commonly occurs in violence perpetrated by a current or former girlfriend, boyfriend, spouse or partner, namely intimate-partner violence (IPV).[3] Among studies examining the frequency of strangulation in women attending domestic violence shelters and emergency rooms, rates have been reported between 57.6% and 68%.[4,5] During a strangulation incident, women may experience a loss of or other alteration in consciousness (AIC; e.g., memory loss, confusion).[6–8] Awareness of an AIC may be important, as an AIC indicates a hypoxic, or ischemic insult to the brain that may be considered an acquired brain injury. This could have an immediate and possibly enduring impact on the survivor's cognitive, psychological, or behavioral functioning.[9–11] Additionally, as strangulation often leaves no visible marks on the survivor's body[2], information about whether a woman has sustained an AIC from strangulation could serve as a flag for other dangerous (e.g., carotid dissection) or possibly fatal outcomes within the following days or weeks of the strangulation. As such, knowledge about potential AICs could be critical to interpreting abuse-related outcomes, improving interventions, and guiding treatments for women who have experienced IPV.

Despite the importance of understanding the consequences of strangulation-related AIC in intimate-partner violence, there are almost no studies directly examining this issue. Previously, we reported that, in a sample of women who had experienced physical partner violence, 27% sustained at least one strangulation-related AIC and 12% sustained repetitive strangulation-related AICs.[6] However, we did not examine the relationship between strangulation-related AICs and potentially negative outcomes such as cognitive difficulties or psychological distress. Rather, we examined the relationship between such outcomes and a brain injury score, based on number, recency and severity of traumatic brain injuries

(TBIs) *combined* with strangulation-related AICs. As the field has grown, the importance of understanding the effects of strangulation-related AICs as acquired brain injuries *specifically* has been recognized.[12] There has also been a call for neuropsychological research using standardized tools.[13] The primary objective of this report is to present a secondary analysis of our previously published data[6] in order to focus specifically on strangulation-related AICs and their relationships to cognitive and psychological outcomes *independent* of TBIs. To this end, we used the Brain Injury Severity Assessment (BISA)[6,14] to identify groups of IPV survivors who had vs. had not experienced a strangulation-related AIC. We then compared the groups on measures of cognitive functioning and psychological distress, while also controlling for the effects of TBIs. Our cognitive battery was chosen to allow us to assess a range of functions while also being brief, portable, and not overly taxing for the women. Also, as the study was originally designed to capture effects of repetitive mild TBIs, our outcome variables were those expected to be affected by such brain injuries. Specifically, we examined strangulation-related AIC's relationship to indices of: learning, long-term and working memory, visuomotor speed, cognitive flexibility, and nonverbal cognitive fluency. Notably, there are no studies that we know of that assess cognitive effects on strangulation that we could use to further guide our selection of tests. Given that other factors such as depression, post-traumatic stress[15–19] and histories of childhood abuse[20,21] (which are more likely to be experienced by women who have experienced partner violence) have been associated with cognitive functioning in women, we controlled for these variables while examining the relationships between strangulation induced AICs and cognitive functioning. We also examined strangulation-related AICs relationship to psychological functioning including: general distress, anxious arousal, anhedonic depression, worry and post-traumatic stress disorder symptomatology. As history of childhood abuse has also been associated with later psychological distress,[22] we controlled for childhood abuse here as well.

Methods

Sample

We recruited a convenience sample via fliers posted where we expected to find women with IPV histories and via word of mouth. To establish a prevalence estimate (previously reported)[6] we included women ages 18–55 who expressed interest, were capable of participating (e.g., non-psychotic, English-speaking), and experienced at least one instance of physical-partner violence. Given that such women often have complex histories, for analyses examining the effects of strangulation-related AICs on cognitive and psychological functioning, we applied additional exclusion criteria to reduce potential confounds and aid in data interpretability. For example, experiences such as severe brain injuries or recent histories of substance dependence that could mask potential effects of strangulation-related AIC and also be difficult to control for were exclusionary. After applying the additional criteria, women were excluded due to: moderate to severe TBIs from previous accidents (n=11), mild TBIs from accidents in the past 12 months (n=4), moderate to severe IPV-related TBIs (n=9), drug dependence within the past 6 months (n=14), alcoholism dependence within the past 6 months (n=10), diabetes (n=3), cerebrovascular accidents (n=2), hydrocephalus (n=1), history of coma resulting in a hospital stay (n=5) and seizures (n=6) occurring prior to physical abuse, Bipolar Disorder (n=3), Schizophrenia

(n=1), physical childhood abuse resulting in disability or loss of consciousness (n=3), and ambiguity regarding whether a potential strangulation-related AIC was from a co-occurring TBI (n=1). After applying these criteria, 52 women remained for analyses. Women who endorsed at least one strangulation-related AIC were in the strangulation group. All others were "controls." Demographic information for the full and sub-sample are reported in Table 1.

Procedure

This study was approved by the ethics committee at the University of Illinois Urbana-Champaign. Women were invited to participate in a study concerning the effects of partner violence on aspects of women's well-being. Data were collected in one or two sessions depending upon the woman's time and preference. Semi-structured interviews were conducted by the principal investigator. Neuropsychological testing was conducted by the principal investigator and two female research assistants who received training through mock evaluations with experienced test administrators (including a board-certified neuropsychologist). Seven women did not complete the second session. Participants provided written informed consent.

Measures

Strangulation—The Brain Injury Severity Assessment (BISA)[6,14] (downloadable from the Acquired Brain Injury toolbox: https://abitoolkit.ca/assets/images/BISA.pdf) was used to assess history of partner and non-partner related AICs, including strangulation-related AICs and TBIs. This measure has been used successfully to assess AICs in IPV survivors in a number of previous publications,[6,7,23–25] and was specifically designed to capture all acquired brain injuries in women who have experienced IPV. The BISA is based on the official definition for mild TBI outlined by the Mild Traumatic Brain Injury Committee of the American Congress of Rehabilitation Medicine[26]. Considering this definition, the semi-structured BISA interview assesses AICs that may occur immediately following a potential trauma to the brain. Participants are asked whether they experienced dizziness, felt stunned or disoriented, seen stars or spots, lost consciousness or blacked out, or had posttraumatic amnesia surrounding the referenced event. For example, "After anything that your partner has ever done to you have you ever lost consciousness or blacked out?" If participants responded affirmatively, they were asked follow-up questions to determine the causal mechanism of the AIC (e.g., being strangled or hit in the head) as well as timing and frequency of the event. An incident was considered a potential anoxic, hypoxic or ischemic brain injury if an AIC resulted from strangulation. An incident was considered a TBI if there were an AIC from traumatic forces to the brain. In the case of loss of consciousness or post-traumatic amnesia, additional questions were asked to determine the duration of each to classify the brain injury as "mild" or "moderate to severe." These data were also collected for non-partner-related brain injuries.

Psychopathology—The Clinician-Administered Post-traumatic stress disorder (PTSD) Scale for DSM-IV—One-Week Symptom Status Version (CAPS-2)[27] was used to assess PTSD. The CAPS-2 is a commonly-used semi-structured interview that measures the

frequency and intensity of PTSD symptoms according to DSM-IV criteria. A single PTSD severity score was computed for each participant.

The Mood and Anxiety Symptom Questionnaire—Short Form[28] was used to assess depression and anxiety. It is a 62-item questionnaire that assesses specific and nonspecific emotional symptoms under the following four subscales: general distress anxious symptoms, anxious arousal, general Distress depressive symptoms, and anhedonic depression. Participants were asked how much they felt/experienced each symptom in the previous week. We combined the two general distress subscales as they are theoretically similar and highly correlated (r =.82). This resulted in three subscale scores: general distress, anxious arousal, and anhedonic depression.

The Penn State Worry Questionnaire[29] was used to assess worry. It is composed of 16 items, which assess the degree participants identify with worry over time and situations, and the uncontrollability and intensity/excessiveness of worry.

Cognitive Measures—Cognitive performance was evaluated with a brief neuropsychological battery of commonly used tests demonstrated to have reasonable reliability and validity. Scores were converted to age-, gender-, and/or education-corrected T- or z-scores with the norming procedures recommended in the manuals for each measure.

The California Verbal Learning Test[30] was used to assess learning and memory. Participants hear a list of words five times and are asked to recall as many words as possible each time (learning). Participants are asked to recall the list again 20 minutes later (long-delay free recall). The learning score was the total number of words recalled z-score during the five learning trials. The long-delay free recall score was the sum of words recalled T-score after the 20-minute delay.

Trail Making Test Part A was used to test visuomotor speed and tracking (TMT-A)[31–32]. Trail Making Test (TMT-B)[31–32] was used to test cognitive flexibility. Participants are asked to connect a series of numbered circles in order (TMT-A) or to connect numbered circles and lettered circles in numerical and alphabetical order, alternating between numbers and letters as quickly as possible (TMT-B). The z-scores for completion times were our outcome measures.

Digit Span, of the Wechsler Adult Intelligence Scale-Revised[33], was used to assess short-term memory. In this task, participants are orally presented with a series of numbers and are asked to repeat the series in the same (digits forward) or reverse (digits backward) order. We used the number of trials z-score as the outcome measure.

The Ruff Figural Fluency Test[34] was used to measure nonverbal cognitive fluency. Participants are asked to create unique patterns connecting 5 dots as quickly as they can for 1 minute. The total number of unique designs T-score was our outcome measure.

Abuse severity—The Childhood Trauma Questionnaire[35] is a 34-item questionnaire that examines childhood abuse and neglect. Participants are asked to report how frequently they experienced a series of undesirable events during childhood (1=never true; 5=very often

true). Scores have been associated with interview-based assessments of childhood abuse[35] and independent corroborations of childhood abuse.[36]

Analysis of variance (ANOVA) was used to compare neuropsychological and psychopathology outcomes of women who had (n=15) or had not (n=37) experienced a strangulation-related AIC. Analysis of covariance (ANCOVA) was used to control for the effects of potential confounds. All analyses were carried out using SPSS Inc. Significance levels were set at $p < .05$.

Results

The 99 women were recruited and assessed between 02/08/97–04/25/99 from shelters (n=67) and programs for relationship support (n=19), protection order assistance (n=2), and substance abuse support (n=6). Five others heard about the study from friends. These women were used to establish prevalence.

Prevalence of women who experienced strangulation

As reported previously[6] 26 women (27%) of the full sample (n=99) reported a history of strangulation-related AIC. For the sub-sample (n=52), the percentage was nearly the same at 29%. Time since most recent strangulation ranged from 1 week to 21 years. Means and standard deviations for the full and sub-sample for variables of interest and covariates are reported in Table 2.

Comparison of cognitive and psychological variables for women who have vs. have not experienced strangulation-*related AIC (n=52)*

For the cognitive variables, ANOVAs revealed that, compared to women who had never experienced strangulation, women who had experienced strangulation performed more poorly on long-delay free recall and showed a trend (p=.09) for poorer performance on digit span. In terms of psychological distress, women who experienced strangulation had higher ratings of anhedonic depression, and PTSD symptomatology, relative to women who had not experienced strangulation. (See Table 3.)

ANCOVAs controlling for potential confounds.—The results, after controlling for a range of potential confounds including mild TBIs, childhood abuse, anhedonic depression and PTSD symptomatology, are summarized in Tables 4 and 5. Between-group differences for long-delay free recall and PTSD symptomatology remained significant while the effect for anhedonic depression was reduced to a trend (p=.06). However, women who had been strangled performed significantly more poorly on digit span than women who were not strangled.

Discussion

Our data showed that women who experienced a strangulation-related alteration in consciousness from IPV performed more poorly on a task of long-term memory, and also reported higher levels of anhedonic depression and PTSD symptomatology than women who had never experienced such strangulation. When controlling for a range of potential

confounding variables, including number of IPV related TBIs, women who had experienced strangulation also performed more poorly on a measure of working memory. Our previous work[6] demonstrated that strangulation-related AICs for women who have experienced IPV occur at an alarmingly high prevalence of 27%. However, this is the first study to examine associations between strangulation-related AICs and cognitive performance and psychological distress. These preliminary data underscore the need for larger studies designed to address this issue.

The driving force behind this paper was to identify whether strangulation-related AICs could be linked with meaningful functional outcomes independent of traumatic brain injuries. We show this to be the case for at least a few measures, including long-term and working memory. No other studies published to date have used formal neuropsychological assessment to examine cognitive outcomes following strangulation. In fact, somewhat surprisingly, very few studies have even addressed the question of possible cognitive impairment or difficulty in women post strangulation. Strangulation-related papers tend to be based on legal, police or hospital-based records that focus on acute visible or physical injuries. In papers that did refer to delayed cognitive outcomes (often by retrospective self-report), memory or “memory loss” (e.g.,[10]) was the most common cognitive outcome cited.[13] Additionally, a review examining the effects of hypoxic-ischemic brain injuries more generally (e.g., from cardiac arrest) identified the most common and prominent disturbances in cognition to be in the areas of attention, speed of processing, memory, and executive function.[37] Thus, finding poorer performance on tests of long-term and working memory for women who experienced strangulation-related AIC is consistent with these findings. As learning is highly dependent on attention, and cognitive flexibility reflects executive functioning, we would have predicted impairments in those cognitive domains as well. However, given our small sample size, we cannot rule out the possibility that there are smaller effects we could not detect. Or it could be that the types of hypoxic-ischemic brain injuries typically reported on (e.g., cardiac arrest) have a different set of cognitive outcomes than hypoxic-ischemic brain injuries of women who are strangled. Larger samples and replication studies are needed to tease this question apart. Nonetheless, our data can be used to help guide expectations of potential cognitive challenges that women who have been strangled may experience with respect to memory. This is important to consider in a rehabilitation setting, for example, where remembering “homework” is required for recovery.

We also found higher levels of anhedonic depression and PTSD symptomatology for women who had vs. had not experienced strangulation-related AIC. These data are consistent with a recent review that found depression and PTSD to be two common psychological outcomes for women reporting strangulation irrespective of AIC.[13] Here we demonstrate more specifically and for the first time, that strangulation-related AIC is a risk factor for higher levels of depression and PTSD symptomatology. The effect for depression dropped to trend-level significance when controlling for potential confounds, including childhood trauma. This could reflect insufficient power given our sample size, but it also suggests a complex relationship between childhood trauma, strangulation-related AIC and anhedonic depression. We did not find general distress, anxiety or worry to be higher for women who experienced strangulation-related AIC, although other studies have suggested that strangulation was

associated with anxiety.[5,9,10,13] Again, given our sample size, it is possible that we were not able to detect smaller effects than the ones detected for PTSD and depression. On the other hand, perhaps anxiety is more likely associated with strangulation more generally. Larger studies designed to systematically address the most common psychological outcomes from strangulation-related AIC are needed.

Limitations

This study was not specifically designed to address this particular set of questions. As such, the sample size is small, limiting how confident we can be regarding our conclusions as well as the analyses we were able to perform. Nonetheless, we were able to identify significant relationships even while controlling for potential confounds. Ideally, we would control for the effects of partner violence to understand the degree to which strangulation-related AIC vs. abuse more generally contributes to the between-group differences. Unfortunately, strangulation is, by definition, very strongly associated with abuse severity, is considered an extreme form of abuse, and is associated with serious injury and a 7-fold increased risk of lethality[38–40] It is reported to be one of the most terrifying experiences of IPV.[41] Also, "choked you" is an item within the abuse severity scale. Therefore, controlling for abuse severity was not logical here as we would undoubtedly be removing variance associated with strangulation itself. With a larger sample and additional abuse severity measures one could control for specific types of abuse (e.g., psychological abuse, sexual coercion) and use more sophisticated modelling techniques (e.g., hierarchical regression) to attempt to tease these two apart. Nonetheless, the data presented here are a critical first step in providing a link between strangulation-related AIC and cognitive and psychological functioning. These results represent much needed preliminary information to support larger studies designed to explore these relationships in greater detail. Also, we were conservative and excluded women with a range of conditions that in our opinion could have confounded results and been difficult to control for statistically. We acknowledge that it is challenging to select the perfect exclusion criteria. Although this limited our power, being the first study of its kind, we chose to err on the conservative side. Another limitation is the lack of established psychometric properties for the BISA. However, the BISA was carefully designed for this population and specifically for addressing strangulation-related AIC. We know of no validated measure that does this. Also, any self-report measure of brain injury runs the risk of participants mis- or not remembering events. However, as most events may go untreated for these women[7,42], any other approach would likely result in underestimates of events. Furthermore, there is no reason to suspect that women would systematically mis-remember in such a way as to cause spurious relationships. If anything, we would expect such "memory" issues to mask potential effects. An additional limitation was that the same researcher collected the cognitive assessment and interview data for the majority of participants, which could lead to confounds and biases. Nonetheless, we felt the need for establishing rapport and trust with this population outweighed having "new" investigators collect the neuropsychological data. A final limitation is our inability to examine whether our effects are moderated by race or ethnicity. This is important for many reasons. For example, data show that risk of strangulation is higher for African American women than for white women, and Native American women are at a greater risk than white women for strangulation with loss of consciousness.[43] In many cases, strangulation leaves no external

marks on the victim.[2] For women with darker skin, it may be especially challenging to observe visible signs of strangulation.[44,45] Thus, inquiring about AICs may be particularly helpful in identifying and characterizing strangulation events across a range of ethnically diverse groups of women (in particular, people of color).

In sum, these preliminary data represent a first step in establishing our knowledge regarding the cognitive and psychological challenges of women who have experienced strangulation-related alterations in consciousness. Strangulation-related AIC is a serious and highly prevalent form of abuse. It is critical that we build on this knowledge to inform stakeholders about the potential dangers to increase the likelihood that appropriate care and interventions will be provided to women who survive this experience.

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TABLE 1 -

Demographic Characteristics for Whole and Sub-sample

Variable		Whole Sample (*n* = 99)	Sub-Sample (*n* = 52)
Age	Range	18–54	18–52
	mean (SD)	32 (9.3)	31.4 (9.2)
Education Level, mean (SD)		12.3 (2.1)	12.5 (1.8)
Ethnicity, *n* (%)	Caucasian	58 (59)	32 (61.5)
	African American	34 (34)	16 (30.8)
	Latina	3 (3)	2 (3.8)
	Native American	3 (3)	2 (3.8)
	Other	1 (1)	0 (0)
Employed, *n* (%)		50 (50.5)	22 (42.3)
Shelter, *n* (%)		68 (68.7)	34 (65.4)

Abbreviations. SD: Standard Deviation; Shelter: Living in a shelter at time of interview.

TABLE 2.

Descriptive Data for Covariates, Independent and Dependent Variables by Full and Sub-sample

		Full Sample mean (SD)	Sub-Sample mean (SD)
Covariates	CTQ	83.6 (37.6)	74.5 (35.8)
	# IPV-related MTBIs	7.6 (10.5)	5.9 (9.2)
DVs - Cognitive	CVLT LDFR	−2.0 (1.6)	−1.6 (1.6)
	CVLT Trials 1–5	31.5 (16.4)	35.1 (18.5)
	TMT A	−.01 (1.1)	.32 (.79)
	TMT B	−1.1 (2.6)	−.40 (1.9)
	RFFT-UD	43.4 (8.5)	43.3 (7.6)
	Digit Span	−.22 (.89)	−.11 (.90)
DVs - Psychological	Worry	57.7 (14.9)	53.2 (14.4)
	General Distress	55.9 (20.8)	52.1 (18.9)
	Anxious Arousal	28.6 (10.3)	26.6 (8.1)
	Anh Depression *	65.8 (16.2)	63.1 (16.1)
	PTSD *	23.0 (26.0)	18.4 (24.2)
IV	Presence of Strangulation-Related AICs (%)	27	29

Abbreviations. AIC: alteration in consciousness; Anh Depression: Anhedonic Depression Subscale of the Mood and Anxiety Symptom Questionnaire; Anxious Arousal: Subscale from the Mood and Anxiety Symptom Questionnaire; CTQ: The Childhood Trauma Questionnaire; CVLT LDFR: Long-delay Free Recall measure for memory from the California Verbal Learning Test; CVLT trials 1–5: Learning trials of the California Verbal Learning Test; DVs: Dependent Variables; General Distress: Subscale from the Mood and Anxiety Symptom Questionnaire; IPV: intimate-partner violence; PTSD: Post-traumatic stress disorder (PTSD) measured by the Clinician Administered PTSD Scale-2; MTBI: mild traumatic brain injury; RFFT-UD: Ruff Figure Fluency Test Unique Designs; TMT A: visuomotor speed and tracking measure of the Trail Making Test; TMT B: measure of cognitive flexibility measured by the Trail Making Test; Worry: Measured by the Penn State Worry Questionnaire.

* Also used as covariates in some analyses.

TABLE 3.

Analysis of Variance Comparing Cognitive and Psychological Variables for Women who Have vs. Have Not Experienced Strangulation-related AIC

	Dependent Variable	Strangulation-related AIC mean (SD)	No strangulation-related AIC mean (SD)	df	F	*p*
Cognition	CVLT LDFR	−2.3 (1.6)	−1.3 (1.6)	50	4.84	.03
	CVLT Trials 1–5	32.3 (18.1)	36.3 (18.8)	50	0.48	.49
	TMT A	.2 (.8)	.37 (.81)	49	0.47	.50
	TMT B	−0.9 (1.9)	−0.18 (1.93)	47	1.41	.24
	RFFT-UD	43.1 (7.6)	43.4 (7.7)	50	0.02	.88
	Digit Span	−.4 (.8)	.02 (.93)	50	2.91	.09
Psychopathology	Worry	58.0 (13.9)	51.0 (14.3)	48	2.23	.14
	General Distress	58.8 (16.9)	49.6 (19.3)	48	2.47	.12
	Anxious Arousal	27.4 (7.9)	26.3 (8.3)	48	0.18	.67
	Anhedonic Depression	70.9 (12.5)	60.1 (16.5)	48	4.83	.03
	PTSD	31.4 (30.5)	13.2 (19.3)	47	6.26	.02

Abbreviations. Anhedonic Depression: Anhedonic Depression Subscale of the Mood and Anxiety Symptom Questionnaire; Anxious Arousal: Subscale from the Mood and Anxiety Symptom Questionnaire; CVLT LDFR: Long-delay Free Recall measure for memory from the California Verbal Learning Test; CVLT trials 1–5: Learning trials of the California Verbal Learning Test; General Distress: Subscale from the Mood and Anxiety Symptom Questionnaire; PTSD: Post-traumatic stress disorder (PTSD) measured by the Clinician Administered PTSD Scale-2; RFFT-UD: Ruff Figure Fluency Test Unique Designs; TMT A: visuomotor speed and tracking measure of the Trail Making Test; TMT B: measure of cognitive flexibility measured by the Trail Making Test; Worry: Measured by the Penn State Worry Questionnaire.

TABLE 4.

Analysis of Covariance Comparing Cognitive Variables for Women who Have vs. Have Not Experienced Strangulation-related AIC while Controlling for IPV-related TBIs, Childhood Trauma and Measures of Psychological Distress

	Dependent Variable					
Model	**CVLT LDFR F (*p*)**	**CVLT Trails 1–5 F (*p*)**	**Digit Span F (*p*)**	**RFFT-UD F (*p*)**	**TMT A F (*p*)**	**TMT B F (*p*)**
# IPV-related MTBIs	.05 (.83)	.79 (.38)	.00 (.98)	.00 (1.00)	.00 (.97)	1.91 (.18)
CTQ	.00 (.98)	.07 (.80)	.41 (.53)	2.47 (.12)	3.54 (.07)	.31 (.59)
PTSD	.48 (.49)	1.73 (.20)	.00 (1.00)	1.42 (.24)	.02 (.89)	.04 (.85)
Anh Depression	.47 (.50)	.66 (.42)	3.11 (.09)	.64 (.43)	.11 (.75)	.00 (.97)
History of Strangulation-Related AIC	5.35 (.03)	.24 (.63)	6.77 (.01)	.51 (.48)	.12 (.73)	1.44 (.24)

Abbreviations. AIC: alteration in consciousness; Anh Depression: Anhedonic Depression Subscale of the Mood and Anxiety Symptom Questionnaire; CTQ: The Childhood Trauma Questionnaire; CVLT LDFR: Long-delay Free Recall measure for memory from the California Verbal Learning Test; CVLT trials 1–5: Learning trials of the California Verbal Learning Test; General Distress: Subscale from the Mood and Anxiety Symptom Questionnaire; IPV: intimate-partner violence; PTSD: Post-traumatic stress disorder (PTSD) measured by the Clinician Administered PTSD Scale-2; MTBI: mild traumatic brain injury; RFFT-UD: Ruff Figure Fluency Test Unique Designs; TMT A: visuomotor speed and tracking measure of the Trail Making Test; TMT B: measure of cognitive flexibility measured by the Trail Making Test; Worry: Measured by the Penn State Worry Questionnaire.

TABLE 5.

Analysis of Covariance Comparing Psychological Variables for Women who Have vs. Have Not Experienced Strangulation-related AIC while Controlling for IPV-related TBIs and Childhood Trauma

	Dependent Variable				
Model	**Anh Depression F (*p*)**	**Anxious Arousal F (*p*)**	**General Distress F (*p*)**	**PTSD F (*p*)**	**Worry F (*p*)**
# IPV-related MTBIs	1.44 (.24)	13.52 (.00)	1.23 (.27)	5.72 (.02)	.105 (.31)
CTQ	7.31 (.01)	2.19 (.15)	6.10 (.02)	2.59 (.11)	2.05 (.16)
History of Strangulation-Related AIC	3.66 (.06)	.03 (.87)	1.60 (.21)	4.35 (.04)	1.50 (.23)

Abbreviations. AIC: Alteration in consciousness; Anh Depression: Anhedonic depression subscale of the MASQ; CTQ: The Childhood Trauma Questionnaire; IPV: Intimate-partner violence; MTBIs: mild traumatic brain injuries; PTSD: Post-traumatic stress disorder measured by the by the Clinician Administered PTSD Scale-2.