**SUPPLEMENTARY MATERIAL**

**Methods**

*Inclusion/Exclusion Criteria*

All participants scored > 21 on the Montreal Cognitive Assessment or > 26 on Mini-Mental State Examination, intact basic and instrumental activities of daily living and had at least 10 years of education. Exclusion criteria included lifetime history of bipolar, psychotic, or neurological disorders, acute suicidality (assessed using the suicide item on the 17-item Hamilton Depression Rating Scale [HAM-D] or judged by a clinician), substance use disorders during the past 5 years, history of neurological illnesses, including seizures, stroke, dementia of any etiology, severe head injury, brain tumor, etc., or delirium/unstable medical conditions determined using the Cumulative Illness Rating Scale-Geriatric version (CIRS-G) score of 4 in any category. Additional exclusion criteria for the Comp participants included any lifetime psychiatric history, death of a loved one within 18-months, HAM-D score > 7 or taking psychotropic medications.

Clinician-administered HAM-D for assessing depressive symptoms, Hamilton Anxiety Rating Scale (HAM-A) for assessing anxiety symptoms and CIRS-G for assessing medical illness burden were completed. Structured Clinical Interview for DSM-5 Research Version (SCID-5-RV) was also completed to assess for depressive, anxiety, psychotic, and substance use disorders. Grief participants who met current DSM-5-TR criteria for depressive, anxiety, or post-traumatic stress disorders on the SCID-5-RV were not excluded. Since this is an observational study, antidepressant medications or low doses of benzodiazepines were allowed as long as the doses remained stable for at least 4 weeks before the visit. Psychotropic medication use was documented.

*Study procedures*

Grief symptom assessment. Bereaved participants (n=93) completed self-reported ICG scale. ICG has excellent psychometric properties and can reliably assess prolonged grief symptoms. The total ICG scores range from 0 to 76. Time since loss (TSL) and relationship of the deceased were also documented in the bereaved.

Neurocognitive measures. Global and specific neurocognitive domains were assessed in all participants. Global cognitive function was measured using the MoCA and the Dementia Rating Scale-2 (DRS-2) Total Score. Specific neurocognitive domains were assessed: Memory using the Immediate and Delayed Paragraph Recall, Language using the Boston Naming Test (BNT) and Category Fluency (animals), Executive function using the Trails Making Test B (Trails B), and attention and information processing speed using the Digit Symbol Substitution Test (DSST) and Trails Making Test A (Trails A).

**Supplementary Tables**

**Table S1.** Demographic and clinical characteristics

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **High Grief**  **(n=44)** | | **Low Grief**  **(n=49)** | | **Comparison Group**  **(n=43)** | | | **Statistics** |
|  | Mean ± SD | IQR | Mean ± SD | IQR | | Mean ± SD | IQR |  |
| **Sociodemographic** |  |  |  |  | |  |  |  |
| Age (years) | 63.6 ± 7.9 | 56-70 | 65.4 ± 9.7 | 58-71 | | 67.0 ± 8.3 | 62-71 | H(2)=2.9, p=0.24 *a* |
| Gender (F/M) | 35/9 |  | 36/13 |  | | 37/6 |  | *x*2(2)=2.2, p=0.33*b* |
| Race (White/Black/Other) | 41/2/1 |  | 45/2/2 |  | | 42/0/1 |  | *x*2(4)=2.3, p=0.68*b* |
| Education (years) | 15.5 ± 2.5 | 13-18 | 16.1 ± 3.1 | 14-17 | | 16.58 ± 2.45 | 16-18 | H(2)=3.9, p=0.14*a* |
|  |  |  |  |  | |  |  |  |
| **Grief Measures** |  |  |  |  | |  |  |  |
| ICG | 40.4 ± 10.7 | 33-42 | 14.7 ± 7.6 | 10-21 | |  |  | H(1)=68.9, **p<0.001***a* |
| Time since loss (days) | 180.3 ± 96.0 | 104-268 | 150.8 ± 81.9 | 80-213 | |  |  | H(1)=1.8, p=0.18*a* |
| Relationship of the deceased (n) |  |  |  |  | |  |  | *x*2(4)=11.1, **p=0.03*b*** |
| Spouse/Parent/Child/Sibling/Other | 16/8/11/4/5 |  | 20/19/2/3/5 |  | |  |  |  |
|  |  |  |  |  | |  |  |  |
| **Psychiatric/Medical Measures** |  |  |  |  | |  |  |  |
| CIRS-G | 6.1 ± 4.3 | 3-9 | 5.3 ± 3.3 | 2-8 | | 4.1 ± 2.8 | 2-6 | H(2)=5.8, p=0.08*a* |
| HAM-A | 10.4 ± 4.8 | 7-13 | 5.4 ± 4.4 | 2-8 | | 2.7 ± 3.3 | 1-3 | H(2)=56.7, **p<0.001***a* |
| HAM-D | 17.3 ± 6.1 | 14-22 | 8.1 ± 5.5 | 4-11 | | 2.6 ± 1.9 | 1-4 | H(2)=82.2, **p<0.001***a* |
|  |  |  |  |  | |  |  |  |
| **Psychiatric Diagnosis** |  |  |  |  | |  |  | *x*2(5)=37.9, **p<0.001*b*** |
| Depressive Disorder only (n) | 23 |  | 4 |  | |  |  |  |
| Anxiety only (n) | 1 |  | 0 |  | |  |  |  |
| PTSD (n) | 1 |  | 0 |  | |  |  |  |
| Comorbid Psychiatric Conditions (n) | 8 |  | 2 |  | |  |  |  |
| Others (n) | 0 |  | 1 |  | |  |  |  |
|  |  |  |  |  | |  |  |  |
| **Antidepressant use** |  |  |  |  | |  |  | *x*2(1)=4.6, p=**0.03*b*** |
| None (n) | 25 |  | 38 |  | |  |  |  |
| Antidepressant use (n) | 19 |  | 11 |  | |  |  |  |
| **Benzodiazepine use (n)** | 4 |  | 2 |  | | 1 |  | *x*2(2)=6.3, p=0.17*b* |
|  |  |  |  |  | |  |  |  |

*IQR, Interquartile range; F, female; M, male; ICG, Inventory of Complicated Grief; CIRS-G, Cumulative Illness Rating Scale–Geriatric; HAM-A, Hamilton Anxiety Rating Scale; HAM-D, 17-item Hamilton Depression Rating Scale; PTSD, Post-Traumatic Stress Disorder.*

*aFor continuous data, significance was evaluated using the Kruskal-Wallis H-test, with degrees of freedom in parentheses.*

*bFor categorical data, significance was evaluated using Chi-Square test, with degrees of freedom in parentheses.*

**Table S2:** Multidomain cognitive measure differences between high grief, low grief, and non-bereaved comparison groups, adjusting for demographics only (reduced model)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cognitive Measures** | **High Grief**  **(n=44)** | | **Low Grief**  **(n=49)** | | **Comp**  **(n=43)** | | **Statistics**\* | **LG versus HG** | **Comp versus HG** |
|  | Mean ± SD | IQR | Mean ± SD | IQR | Mean ± SD | IQR | W, p-value | Mean Difference ± SE, p-value | Mean Difference ± SE, p-value |
| **Global Cognition** |  |  |  |  |  |  |  |  |  |
| MoCA\* | 25.9 ± 2.4 | 24-28 | 26.8 ± 2.7 | 25-29 | 27.3 ± 1.6 | 26-28 | 7.92, **0.02** | 0.9 ± 0.5, 0.07 | 1.2 ± 0.4, **0.005** |
| DRS-2 Total | 140.3 ± 3.0 | 139-142 | 141.3 ± 2.8 | 140-143 | 141.6 ± 1.7 | 140-143 | 5.85, **0.05** | 0.9 ± 0.5, 0.09 | 1.1 ± 0.5, **0.02** |
| **Memory** |  |  |  |  |  |  |  |  |  |
| Immediate Paragraph Recall | 13.6 ± 3.5 | 12-16 | 14.0 ± 3.2 | 12-16 | 14.4 ± 3.4 | 12-17 | 0.12, 0.94 |  |  |
| Delayed Paragraph Recall | 11.7 ± 0.6 | 9-14 | 12.2 ± 3.9 | 9-15 | 12.5 ± 3.9 | 10-15 | 0.37, 0.83 |  |  |
| **Language** |  |  |  |  |  |  |  |  |  |
| Boston Naming Test\*\* | 55.7 ± 3.7 | 53-59 | 57.2 ± 2.1 | 57-59 | 57.7 ± 2.1 | 56-59 | 12.23, **0.002** | 1.3 ± 0.6, **0.02** | 1.9 ± 0.5, **<0.001** |
| Category Fluency | 22.7 ± 4.8 | 19-26 | 24.3 ± 4.8 | 21-28 | 24.4 ± 5.0 | 21-27 | 3.71, 0.16 |  |  |
| **Executive Function** |  |  |  |  |  |  |  |  |  |
| Trails B | 80.9 ± 31.4 | 59-93 | 76.4 ± 26.8 | 59-94 | 72.9 ± 27.6 | 55-85 | 3.44, 0.18 |  |  |
| **Attention/Processing Speed** |  |  |  |  |  |  |  |  |  |
| Digit Symbol Substitution Test | 48.3 ± 10.3 | 41-57 | 52.3 ± 9.1 | 46-60 | 52.2 ± 10.2 | 45-60 | 10.20, **0.006** | 4.9 ± 1.7, **0.003** | 4.7 ± 1.8, **0.01** |
| Trails A | 33.9 ± 12.2 | 25-41 | 32.8 ± 9.8 | 26-39 | 30.8 ± 9.0 | 26-36 | 3.19, 0.20 |  |  |

*Statistical analyses conducted using generalized estimating equations-fitted linear models. \*Statistical analyses conducted after adjusting for covariates (age, gender, and education). p<0.05 highlighted in bold. IQR, Interquartile range; SD, Standard Deviation; W, Wald Chi-Square statistic; Adjusted Mean difference (LG – HG and Comp – HG); SE, Standard Error; Comp, Comparison Group. MoCA, Montreal Cognitive Assessment; DRS-2, Dementia Rating Scale-2.*

*\*\*n = 132 (n = 2 Comparison Group participants and n = 2 Low Grief participants missing MoCA. Note. Participants without MoCA scores had Mini-Mental State Examination score >26)*

*\*\*\*n = 135 (n = 1 Comparison Group participant missing Boston Naming Test)*

**Table S3:** Multidomain cognitive measure differences between high grief, low grief, and non-bereaved comparison groups, adjusting for demographics and depressive symptoms (full model)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cognitive Measures** | **High Grief**  **(n=44)** | | **Low Grief**  **(n=49)** | | **Comp**  **(n=43)** | | **Statistics** | **LG versus HG** | **Comp versus HG** |
|  | Mean ± SD | IQR | Mean ± SD | IQR | Mean ± SD | IQR | W, p-value | Mean Difference±SE,  p-value | Mean Difference±SE,  p-value |
| **Global Cognition** |  |  |  |  |  |  |  |  |  |
| MoCA\* | 25.9 ± 2.4 | 24-28 | 26.8 ± 2.7 | 25-29 | 27.2 ± 1.6 | 26-28 | 0.25, 0.88 |  |  |
| DRS-2 Total | 140.2 ± 3.0 | 139-142 | 141.3 ± 2.8 | 140-143 | 141.6 ± 1.7 | 140-143 | 0.28, 0.87 |  |  |
| **Memory** |  |  |  |  |  |  |  |  |  |
| Immediate Paragraph Recall | 13.6 ± 3.5 | 12-16 | 14.0 ± 3.2 | 12-16 | 14.4 ± 3.4 | 12-17 | 1.92, 0.38 |  |  |
| Delayed Paragraph Recall | 11.7 ± 0.6 | 9-14 | 12.2 ± 3.9 | 9-15 | 12.5 ± 3.9 | 10-15 | 1.95, 0.38 |  |  |
| **Language** |  |  |  |  |  |  |  |  |  |
| Boston Naming Test\*\* | 55.7 ± 3.7 | 53-59 | 57.2 ± 2.1 | 57-59 | 57.7 ± 2.1 | 56-59 | 1.08, 0.58 |  |  |
| Category Fluency | 22.7 ± 4.8 | 19-26 | 24.3 ± 4.8 | 21-28 | 24.4 ± 5.0 | 21-27 | 1.83, 0.40 |  |  |
| **Executive Function** |  |  |  |  |  |  |  |  |  |
| Trails B | 80.9 ± 31.4 | 59-93 | 76.4 ± 26.8 | 59-94 | 72.9 ± 27.6 | 55-85 | 13.79, **0.001** | -16.9 ± 5.7, **0.003** | -26.6 ± 7.2, **<0.001** |
| **Attention/Processing Speed** |  |  |  |  |  |  |  |  |  |
| Digit Symbol Substitution Test | 48.3 ± 10.3 | 41-57 | 52.3 ± 9.1 | 46-60 | 52.2 ± 10.2 | 45-60 | 7.78, **0.02** | 5.6 ± 2.1, **0.006** | 6.0 ± 2.6, **0.02** |
| Trails A | 33.9 ± 12.2 | 25-41 | 32.8 ± 9.8 | 26-39 | 30.8 ± 9.0 | 26-36 | 2.02, 0.36 |  |  |

*Statistical analyses conducted using generalized estimating equations-fitted linear models. \*Statistical analyses conducted after adjusting for covariates (age, gender, education, and HAM-D). p<0.05 highlighted in bold.*

*IQR, Interquartile range; SD, Standard Deviation; W, Wald Chi-Square statistic; Adjusted Mean Difference (LG – HG and Comp – HG); SE, Standard Error; Comp, Comparison Group; MoCA, Montreal Cognitive Assessment; DRS-2, Dementia Rating Scale-2.*

*\*n = 132 (n = 2 Comparison Group and n =2 Low Grief participants missing MoCA. Note. Participants without MoCA scores had Mini-Mental State Examination score >26)*

*\*\*n = 135 (n = 1 Comparison Group participant missing Boston Naming Test)*

**Table S4.** The relationship between neurocognitive measures and grief severity (ICG) in bereaved participants, after adjusting for age, gender, education, and time since loss

|  |  |  |  |
| --- | --- | --- | --- |
| **Independent Variable** | **Coefficient (95% CI)** | **Wald Chi-Square** | **p-value** |
| **Global Cognition** |  |  |  |
| MoCA\* | -1.6 (-3.0 to -0.2) | 5.24 | **0.02** |
| DRS-2 Total | -1.5 (-2.8 to -0.2) | 4.79 | **0.03** |
| **Memory** |  |  |  |
| Immediate Paragraph Recall | -0.7 (-1.6 to 0.2) | 2.36 | 0.12 |
| Delayed Paragraph Recall | -0.7 (-1.5 to 0.2) | 2.43 | 0.12 |
| **Language** |  |  |  |
| Boston Naming Test | -1.6 (-2.8 to -0.4) | 6.87 | **0.009** |
| Category Fluency | -0.5 (-1.2 to 0.1) | 2.48 | 0.12 |
| **Executive Function** |  |  |  |
| Trails B | 0.1 (-0.1 to 0.3) | 1.43 | 0.23 |
| **Attention/Processing Speed** |  |  |  |
| Digit Symbol Substitution Test | -0.5 (-0.9 to -0.1) | 6.06 | **0.01** |

*Statistical analyses conducted using generalized estimating equations-fitted linear models. df = 1. p<0.05 highlighted in bold.*

*ICG, Inventory of Complicated Grief; CI, confidence interval; MoCA, Montreal Cognitive Assessment; DRS-2, Dementia Rating Scale-2. \*n = 91 (n = 2 Low Grief participants missing MoCA. Note. Participants without MoCA scores had Mini-Mental State Examination score >26)*