Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

Analysis of mean of least, average and worst NRS pain over past week (LAW-NRS)

At baseline, LAW-NRS had a mean (SD) of 5.69 (1.7) in the in-person CBT group and 5.37 (1.5) in the IVR-CBT group (5.53 (1.6) overall). The correlation between average NRS over past week (primary outcome) and NRS-LAW was very high (0.95).

At 3 months (primary endpoint), the adjusted change from baseline in LAW-NRS was -0.55 (95% CI (-1.07, -0.03)) for IVR-CBT and -0.69 (95% CI (-1.25, -0.13)) for in-person CBT (Table eTable1, Mixed model results). IVR-CBT was non-inferior to in-person CBT in LAW-NRS change from baseline at 3 months: mean difference between groups: 0.14; 95% CI -0.61 to 0.89, with an upper limit (0.89) below the non-inferiority margin of 1 (p-value non-inferiority =0.01). The non-inferiority of IVR was sustained at later follow-up occasions. After multiple imputation, the upper limits of the 95% confidence intervals for difference between IVR-CBT and in-person CBT was closer to 1, but remained below the non-inferiority margin of 1 at every time point.

eTable1. Change from Baseline in LAW-NRS and Between-Group Differences (estimates from mixed model and multiple imputation estimates)

			Change from baseline, Mean (95%CI)			
Follow-Up Month	**N**	**In-person CBT**	**N**	**IVR-CBT**	**Difference IVR-CBT vs. In-person CBT Mean (95%CI)**	**P-value non-inferiority of IVR**
LAW-NRS *(past week)(N=104)*						
Mixed model results*						
3	42	-0.69 (-1.25, -0.13)	52	-0.55 (-1.07, -0.03)	0.14 (-0.61, 0.89)	0.01
6	45	-0.91 (-1.39, -0.42)	49	-1.14 (-1.61, -0.67)	-0.23 (-0.89, 0.43)	<0.001
9	45	-0.53 (-1.11, 0.05)	49	-0.52 (-1.07, 0.04)	0.01 (-0.78, 0.81)	0.008
Multiple imputation results+ *(N=125)*						
3	63	-0.82 (-1.38, -0.26)	62	-0.57 (-1.08, -0.06)	0.25 (-0.48, 0.987)	0.02
6	63	-1.04 (-1.54, -0.54)	62	-1.09 (-1.57, -0.62)	-0.06 (-0.73, 0.62)	0.001
9	63	-0.55 (-1.13, 0.02)	62	-0.47 (-1.04, 0.10)	0.08 (-0.69, 0.86)	0.01

*The means are LS-mean estimates from mixed model adjusting for treatment, time, time-by-treatment interactions, baseline LAW-NRS and stratification variables. +LS-mean estimates from fitting the same mixed model to the multiply imputed data.

Baseline characteristics of participants included in the primary analysis

Table showing the baseline characteristics of the 104 participants included in the primary analysis, overall and by treatment group.

eTable 2: Baseline Characteristics of Participants Included in the Primary Analysis by Treatment Group

Sociodemographic Characteristics	All (N=104)	In-person (N=50)	IVR (N=54)
Age, M (SD), *y*	57.8 (11.2)	56.8 (10.6)	58.6 (11.7)
Sex, N (%female)	22 (21.2)	12 (24.0)	10 (18.5)
Race/Ethnicity, N (%)			
Black, not Hispanic	23 (22.3)	11 (22.4)	12 (22.2)
Hispanic	9 (8.74)	6 (12.2)	3 (5.56)
White, not Hispanic	68 (66.0)	31 (63.3)	37 (68.5)
Other	3 (2.91)	1 (2.04)	2 (3.70)
Education, M (SD),*y*	13.9 (2.13)	14.2 (2.29)	13.7 (1.95)
Employment, N (%)			
Full-Time	23 (22.1)	15 (30.0)	8 (14.8)
Part Time	12 (11.5)	6 (12.0)	6 (11.1)
Unemployed	16 (15.4)	4 (8.00)	12 (22.2)
Retired	30 (28.8)	13 (26.0)	17 (31.5)
Student	5 (4.81)	2 (4.00)	3 (5.56)
Disabled	18 (17.3)	10 (20.0)	8 (14.8)
Relationship Status, N (%)			
Single	24 (23.1)	13 (26.0)	11 (20.4)
Married	48 (46.2)	24 (48.0)	24 (44.4)
Significant Other (if >10 months)	1 (0.96)	0 (0.00)	1 (1.85)
Divorced/Separated	27 (26.0)	12 (24.0)	15 (27.8)
Widowed	4 (3.85)	1 (2.00)	3 (5.56)
Distance to VA, N (%)			
<10 miles	23 (22.1)	11 (22.0)	12 (22.2)
10-25 miles	37 (35.6)	20 (40.0)	17 (31.5)
>25 miles	44 (42.3)	19 (38.0)	25 (46.3)
History of Substance Abuse, N (%yes)	27 (26.0)	10 (20.0)	17 (31.5)
Pain Characteristics			
Back Pain Intensity, M (SD)	6.39 (1.49)	6.48 (1.61)	6.31 (1.38)
Back Pain Duration, (Mdn, IQR), *y*	12 (6.0;25.0)	11.5 (6.0;24.8)	12.5 (6.0;28.8)
Back Pain Cause, N (%)			
Non-specific	59 (56.7)	29 (58.0)	30 (55.6)
Radiculopathy or spinal stenosis	44 (42.3)	21 (42.0)	23 (42.6)
Other Cause	1 (0.96)	0 (0.00)	1 (1.85)
Number of Pain Sites, M (SD)	2.95 (2.00)	2.94 (1.77)	2.96 (2.22)
Leg Pain, N (%yes)	63 (60.6)	31 (62.0)	32 (59.3)
Foot Pain, N (%yes)	36 (34.6)	20 (40.0)	16 (29.6)

Arm Pain, N (% yes)	27 (26.0)	12 (24.0)	15 (27.8)
Shoulder Pain, N (% yes)	46 (44.2)	24 (48.0)	22 (40.7)
Neck Pain, N (%yes)	47 (45.2)	22 (44.0)	25 (46.3)
Primary & Secondary Outcome Scores			
Pain NRS average, M(SD)	5.52 (1.59)	5.54 (1.63)	5.50 (1.56)
RMDQ, M (SD)	12.9 (4.61)	13.6 (4.58)	12.1 (4.55)
BDI II, M (SD)	9.99 (7.45)	10.1 (7.70)	9.85 (7.29)
PSQI global, M (SD)	10.2 (4.27)	11.3 (3.86)	9.16 (4.43)
WHYMPI interference subscale, M (SD)	3.00 (1.29)	3.30 (1.32)	2.72 (1.20)
SF-36V physical, M(SD)	35.3 (6.70)	33.8 (6.71)	36.8 (6.41)
SF-36V mental, M (SD)	49.4 (8.18)	49.2 (7.85)	49.7 (8.54)
Other outcomes			
Opioid prescription at baseline, N (%yes)	15 (14.4)	9 (18.0)	6 (11.1)

Note: The variables in eTable2 have the same meaning as Table 1 in the text.

Per-protocol analysis of the primary outcome

eTable 3: Primary Outcome Change from Baseline and Between-Group Differences: Per Protocol Analysis Results

			Change from baseline, Mean (95%CI)			
Follow-Up Month	**N**	**In-person CBT**	**N**	**IVR-CBT**	**Difference IVR-CBT vs. In-person CBT, Mean (95%CI)**	**P-value non-inferiority (IVR-CBT)**
Average Pain Intensity NRS *(past week) (N=97)*						
3	40	-0.95 (-1.5, -0.39)	50	-0.9 (-1.42, -0.39)	0.04 (-0.70, 0.79)	0.006
6	42	-1.11 (-1.66, -0.56)	47	-1.27 (-1.79, -0.75)	-0.16 (-0.91, 0.58)	0.001
9	41	-0.60 (-1.20, 0.01)	47	-0.57 (-1.14, 0.00)	0.03 (-0.79, 0.85)	0.010

The means are LS-mean estimates from mixed model adjusting for treatment, time, time-by-treatment interactions, baseline average pain intensity and stratification variables. Analysis was restricted to the per-protocol population (subjects who completed ≥3 treatment sessions).

Multiple Imputation Implementation and Results

The imputation model included the primary/secondary outcomes (average pain intensity, WHYMPI, RMDQ, PSQI, BDI-II, SF-36V PCS and SF-36V MCS) measured at all four time points, treatment group, stratification variables (distance from VA facility and back pain cause), and the baseline variable identified as predictive of missingness (race, SLUMS dementia screen score and back pain duration). The longitudinal nature of the data was accommodated by transforming the data to a wide format (containing a single row of data for each subject). We imputed missing values 100 times via chained equations as implemented in the R package mice.[1] The imputed datasets were analyzed using mixed models similar to those presented in the primary manuscript. The multiple imputation results for primary/secondary analyses are presented in eTable4.

eTable 4: Primary and Secondary Outcomes Change from Baseline and Between-Group Differences: Multiple Imputation Results

			Change from baseline, Mean (95%CI)			
Follow-Up Month	**N**	**In-person CBT**	**N**	**IVR-CBT**	**Difference IVR-CBT vs. In-person CBT, Mean (95%CI)**	**P-value non-inferiority (IVR-CBT)**
Average Pain Intensity NRS *(past week) (N=125)*						
3	63	-0.93 (-1.49, -0.37)	62	-0.72 (-1.23, -0.21)	0.21 (-0.53, 0.94)	0.018
6	63	-1.12 (-1.67, -0.58)	62	-1.16 (-1.68, -0.64)	-0.04 (-0.78, 0.69)	0.003
9	63	-0.49 (-1.06, 0.09)	62	-0.48 (-1.03, 0.07)	0.01 (-0.79, 0.80)	0.007
Follow-Up Month		**In-person CBT**		**IVR**	**Difference IVR-CBT, Mean (95%CI)**	**P-value difference between groups**
WHYMPI total (N=125)						
3	63	-0.06 (-0.37, 0.24)	62	-0.36 (-0.65, -0.07)	-0.3 (-0.71, 0.11)	0.16
6	63	-0.01 (-0.39, 0.37)	62	-0.34 (-0.72, 0.03)	-0.34 (-0.86, 0.18)	0.21
9	63	-0.07 (-0.47, 0.34)	62	-0.13 (-0.52, 0.27)	-0.06 (-0.61, 0.48)	0.82
RMDQ total (N=125)						
3	63	-2.46 (-3.89, -1.04)	62	-3.04 (-4.32, -1.76)	-0.57 (-2.46, 1.32)	0.55
6	63	-1.91 (-3.35, -0.47)	62	-3.6 (-5.00, -2.19)	-1.68 (-3.68, 0.31)	0.10
9	63	-1.96 (-3.30, -0.62)	62	-2.6 (-3.91, -1.29)	-0.64 (-2.48, 1.21)	0.50
PSQI total (N=125)						
3	63	-1.35 (-2.41, -0.3)	62	-1.95 (-2.85, -1.05)	-0.6 (-1.94, 0.75)	0.39
6	63	-1.2 (-2.12, -0.28)	62	-1.52 (-2.40, -0.64)	-0.32 (-1.55, 0.91)	0.61
9	63	-1.44 (-2.56, -0.31)	62	-1.04 (-2.06, -0.02)	0.4 (-1.08, 1.87)	0.60
BDI-II total (N=125)						
3	63	-1.23 (-3.18, 0.72)	62	-1.25 (-3.09, 0.58)	-0.02 (-2.58, 2.53)	0.99
6	63	0.80 (-1.35, 2.95)	62	-0.62 (-2.76, 1.53)	-1.42 (-4.39, 1.55)	0.35
9	63	1.56 (-1.00, 4.12)	62	0.88 (-1.63, 3.39)	-0.68 (-4.17, 2.81)	0.70
SF-36V PCS (N=125)						
3	63	2.38 (0.55, 4.22)	62	2.49 (0.78, 4.21)	0.11 (-2.36, 2.57)	0.93
6	63	1.14 (-0.87, 3.15)	62	2.46 (0.53, 4.40)	1.32 (-1.41, 4.06)	0.34
9	63	2.12 (-0.02, 4.27)	62	1.48 (-0.56, 3.53)	-0.64 (-3.53, 2.25)	0.66
SF-36V MCS (N=125)						
3	63	0.35 (-1.95, 2.66)	62	1.72 (-0.33, 3.78)	1.37 (-1.65, 4.39)	0.37
6	63	0.97 (-1.50, 3.45)	62	1.42 (-0.95, 3.79)	0.44 (-2.88, 3.77)	0.79
9	63	-1.53 (-4.17, 1.11)	62	0.46 (-2.11, 3.02)	1.98 (-1.60, 5.57)	0.28

LS-mean estimates from fitting mixed models to the multiply imputed data

eReference

1. Buuren, S, Groothuis-Oudshoorn, K. MICE: Multivariate imputation by chained equations in R. *Journal of statistical software*. 2011; *45*(3):1-67.