

Efficacy of a Virtual Positive Psychology-based Intervention with an Artificial Intelligence-based App for Loneliness and Depression: A Randomized Control Trial

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The pandemic has brought about a great amount of distress among people all over the world. The victims of the infection and their families have suffered from physical and mental issues. Such situations call for infusing positivity and building hope among the sufferers. Positive Psychology postulates that the absence of “Negative”, that is the absence of disease, does not ensure well-being. Applying this construct, an intervention model was constructed and named “The C. A. R. E Intervention Model”. C: stands for Compassion and Self Compassion, A: stands for Achieving a Purpose in Life, R: stands for Relationship Building, and E: stands for Enhancing Positive Emotions. The intervention consisted of activities and exercises designed to develop compassion and self-compassion, achieve a sense of purpose in life, build relationships and enhance positive emotions.

Eighty-nine participants in the age range of 20 to 35 years, selected through purposive sampling method. All of them were either victims of the infection or were primary care givers. They were initially screened using the Beck’s Depression Inventory (Beck et al., 1988) and the UCLA Loneliness Scale (Russell, 1996). The participants were then randomly assigned to an experimental group -1 of 30 participants, experimental group -2 of 30 participants and a wait list control group of 29 participants. The C. A. R. E intervention was then administered over duration of 28 sessions, four days a week to the participants from the experimental group -1. The experimental group -2 was assigned an interaction with Woebot, an Artificial Intelligence based therapeutic tool. The Wait List Control group was not given any treatment. The assessments were repeated after the intervention. Results indicated that the C. A. R. E intervention was more successful than the Woebot app in reducing the Depression and Loneliness.

Keywords: Depression, Loneliness, Positive Psychology, C. A. R. E Intervention

The past two years have been highly stressful for the whole world. The pandemic that had begun its cataclysmic effects in the late 2019, has continued to bring woes to millions of people across the world for the past two years. People, who have been infected with the virus, have had long lasting physical and mental effects. The virus does not just affect one person but is highly infectious and spreads through contact and thus if one person in the family gets infected, usually

there are other family members and contacts who are also infected. This causes a great amount of guilt to the originally infected person as he or she is the carrier of the disease and has caused suffering for many other innocent contacts. This guilt is usually long lasting and has huge mental health ramifications. This paper attempts to help such victims of the pandemic overcome the Depression and Loneliness caused by the guilt, shame and the forced social distancing

caused by the pandemic for its victims. A brief review of literature on the constructs taken up for study was conducted.

Parks and Boucher (2020) showed the effects of Digital Positive Psychology Interventions during the COVID were digitally delivered inducing gratitude, happiness, hope and optimism etc. were beneficial in reducing the loneliness caused due to the social distancing parameters of the pandemic. In another study by Waters et al. (2021) demonstrated how collective well-being were brought about through Positive Psychology Interventions. The outcome for this study maps the post- traumatic development after the COVID 19 pandemic. A similar study by Waters et al (2021) revealed the buffering, mental health bolstering effects of positive psychology-based interventions during the pandemic. Carr et al. (2020) steered a meta-analysis of the efficacy of Positive Psychology Interventions to bring about well-being studied as many as 347 studies, involving participants numbering more than 72,000 belonging to 41 countries. It reported that the Positive Psychology Interventions had great effect on stress, anxiety, depression, quality of life, strengths, and overall well-being. Moreover, in a study on the efficacy of Compassion Focused Therapy on COVID survivors by Sudha and Gayatridevi (2021a, 2021 b), it was reported that psychological well-being could be rebuilt using positive psychological constructs focused therapy. The above brief review suggested that it is indeed essential to develop a Positive Psychology Based Intervention in the Indian context to help the victims of the pandemic.

This study included the following objectives:

- To identify the levels of Loneliness and Depression among the participants
- To find out the efficacy of the C. A. R. E intervention and the Woebot App

in reducing the Loneliness and Depression in the participants

The Hypotheses for the study were as follows:

- There will not be a significant difference in the levels of Depression in the Pretest and Post test scores of the participants in the Experimental group -1 (C. A. R. E Intervention), Experimental group -2 (Woebot App) and the Wait List Control Group (No intervention).
- There will not be a significant difference in the levels of Loneliness in the Pretest and Post test scores of the participants in the Experimental group -1 (C. A. R. E Intervention), Experimental group -2 (Woebot App) and the Wait List Control Group (No intervention).
- There will not be a significant difference between the Experimental group -1 (C. A. R. E Intervention), Experimental group -2 (Woebot App) and the Wait List Control Group (No intervention) in the post test phase.

Method

The study used the following tools:

- The UCLA Loneliness scale ((Russell, 1996) consists of 20 items with a four-point Likert type rating scale measuring Loneliness.
- The Beck's Depression Inventory (Beck et al., 1988) consists of 21 item inventory that rates the level of Depression.
- Eighty-nine participants in the age group of 20 to 35 years, selected through Purposive Sampling Method. All of them were either victims of the infection or were primary care givers. All the participants were female and had undergone some loss connected

with COVID pandemic. The participants were approached through referrals from various sources and hence the group was formed.

After an informed consent, they were first assessed using the aforesaid tools. The participants were then randomly assigned to an experimental group -1 of 30 participants, experimental group -2 of 30 participants and a wait list control group of 29 participants. The C. A. R. E intervention was then administered over duration of 28 sessions, four days a week to the participants from the experimental group -1. The experimental group -2 was assigned an interaction with Woebot, an Artificial Intelligence based therapeutic tool. They were encouraged to interact with the app on a daily basis. The participants were asked to maintain a journal on the interaction process, the duration, the nature of interaction (conversation/ video) and also the number of times (frequency) of interaction in a day. A feedback session was held every 3 days to understand the nature of interaction taking place. The Wait List Control group was not given any treatment.

C. A. R. E Intervention Schedule

Requirements: One Journal/ note book for writing down experiences each day.

Seven activities each for Compassion and Self Compassion, achieving a Purpose in Life, Relationship Building and Enhancing Positive Emotions are spread through the 28 days calendar.

Relaxation Exercises such as Counted Breathing, Deep Breathing, breathing from the Stomach, and Jacobson's Progressive Muscle Relaxation (for a period of 30 to 40 minutes every day in the morning) is also given every day. A feedback session was organized every week to discuss about the doubts of the participants and it was clarified.

A sample 4 days activity of the 28 days long calendar with activities every day is given below.

On day one, the focus of the activities was on developing Compassion. This activity required the participant to choose a kind task (Donate money/time/clothing, Smile and wish someone when they least expect it, show concern to someone, Give your time and pleasantness to someone from your family).

Day two consisted of activities striving to build Optimism. The participant is asked to deliberately consider an adverse event that has happened to them in the past 15 days and look at the advantages/positives deliberately hidden behind the negative emotion associated (Examples given to the participants). They are then required to write down a thought opposed to the negative thinking associated with the adverse event.

Day three comprised of helping to build Resilience. Here, the participant must think of a stressful situation weighing them down. They are asked to write it down in detail. Also, to write down ways in which they believe they can challenge themselves and bounce back from the negativity. They are asked to imagine that the stressful event is a cloud spreading over them. They are then required to break through the barrier and build on thoughts focusing on building the strength to bounce back.

Similarly, each day comprises activities to build one particular positive psychology construct. The constructs included were creating a sense of purpose, building good relationships, constructing one positive emotion of their choice, developing self compassion, understanding and practising gratitude even for small things in life, exploring their strengths through an activity, building hope and happiness, spreading smiles, and overcoming obstacles in the path to positivity.

The pretest was conducted using the two psychological tests specified above. After the before intervention tests, the intervention was conducted for 28 sessions. After the intervention, the psychological tests were repeated. The results were tabulated and the data analyzed using the SPSS version 21.

Results and Discussion

Distribution analysis for the levels of Loneliness and Depression among the participants were analysed and tabulated in the table below.

Table 1. Distribution Analysis of Loneliness and Depression among the participants

N=89

S.No	Levels	Loneliness		Depression	
		Number	Percent	Number	Percent
1	High	34	34	36	40
2	Moderate	48	43	45	51
3	Low	7	23	8	9

Percentages are rounded off

Table 1 shows that 34 per cent of the participants had high loneliness, 43% had moderate and 23% had low loneliness. Also, 40% of the participants had high depression, 51% had moderate and 9% had low levels of Depression.

Next, the Shapiro Wilk Test of Normality was done to analyze if the pretest scores of the three groups (Experimental group1, Experimental group -2 and the Waitlist Control Group) are normally distributed. The results are presented in table 2.

Table 2. Shapiro Wilk Test of Normality for the pretest scores of Depression and Loneliness among participants

	Levels	Shapiro-Wilk test of Normality		
		Statistic	df	Significance
Before Intervention	Experimental group -1	0.94	30	0.075

Depression	(C. A. R. E Intervention)				
	Experimental group -2 (WoebotApp)	0.94	30	0.087	
	Wait List Control Group	0.96	29	0.253	
	Before Intervention Loneliness	Experimental group -1 (C.A.R.E Intervention)	0.97	30	0.405
		Experimental group -2 (WoebotApp)	0.97	30	0.472
		Wait List Control Group	0.94	29	.084

Table 2 shows that the significant values for the Experimental group -1 (C. A. R. E Intervention) is 0.075, while the significance for the Experimental group -2 (Woebot App) is 0.087 and 0.253 for the Control group in the variable of Depression. As the significance values are all above >0.05, they were normally distributed. Also, significant values for the Experimental group -1 (C. A. R. E Intervention) is 0.405, while the significance for the Experimental group -2 (Woebot App) is 0.472 and 0.084 for the Control group in the variable of Loneliness. All the three groups were normally distributed on Depression and Loneliness. Since the scores are normally distributed, the Paired samples t-test and the Independent samples t-test is conducted to analyse any significant differences between the groups. Paired samples t-test was conducted to assess the difference in the Before Intervention and After Intervention scores during Before and After Intervention phases.

Table 2 indicates that there is a significant difference between the Pretest and Post test Scores of Depression and Loneliness in the Experimental group -1 (C. A. R. E

Intervention) and the Experimental group -2 (Woebot App), while there is no significant difference in the Pretest and Post test scores of the Control Group indicating that both the C. A. R. E Intervention and the Woebot App

have been effective in reducing Depression and Loneliness among the participants of the Experimental group -1 and Experimental group -2.

Table 3. Paired samples t-test for Depression and Loneliness in the Pretest and Post-test Phases in the Experimental group -1, Experimental group -2 and Waitlist Control Group among the participants

Pairs	Variables	Mean	N	Standard Deviation	t
Pair 1 Experimental group -1 (C. A. R. E Intervention)	Depression Pretest	23.80	30	3.56	15.64**
	Depression Post test	9.07	30	2.94	
Pair 2 Experimental group -2 (Woebot App)	Depression Pre test	23.90	30	3.26	4.61**
	Depression Post test	19.30	30	3.65	
Pair 3 Waitlist Control Group	Depression Pre test	24.93	29	2.98	1.49 ^{NS}
	Depression Post test	24.34	29	3.27	
Pair 4 Experimental group -1 (C. A. R. E Intervention)	Loneliness Pre test	56.53	30	12.94	7.81**
	Loneliness Post test	38.20	30	10.32	
Pair 5 Experimental group -2 (Woebot App)	Loneliness Pre test	55.70	30	12.48	5.54**
	Loneliness Post test	47.73	30	9.41	
Pair 6 Wait List Control Group	Loneliness Pre test	58.59	29	8.86	1.73 ^{NS}
	Loneliness Post test	56.24	29	12.33	

** = Significant at 0.01 level

* = Significant at 0.05 level

NS = Not Significant

Hence the Hypothesis, “There will not be a significant difference in the levels of Depression in the Pretest and Post test scores of the participants in the Experimental group -1 (C. A. R. E Intervention), Experimental group -2 (Woebot App) and the Wait List Control Group (No intervention)” is partially accepted.

Also, the Hypothesis, “There will not be a significant difference in the levels of Loneliness in the Pretest and Post test scores of the participants in the Experimental group -1 (C. A. R. E Intervention), Experimental group -2 (Woebot App) and the

Wait List Control Group (No intervention)” is partially accepted.

Analysis of Variance was performed to analyze the significant differences between the three groups in Depression and Loneliness, the results are tabulated below.

Table 4 indicates that the Mean and Standard Deviation for Experimental group -1, Experimental group -2 and Control Group on Depression After Intervention scores of the Experimental group -1, that is the C. A. R. E Intervention group had the least level of Depression among the three groups.

Table 4. Mean and Standard Deviation for Experimental group -1, Experimental group - 2 and Control Group on Depression

Groups	N	Mean	Standard Deviation
Experimental group -1	30	9.07	2.94
Experimental group -2	30	19.30	3.65
Control Group	29	24.34	3.27

Table 5. ANOVA for significant difference between groups on Depression

	Sum of Squares	df	Mean Square	F
Between Groups	3589.53	2	1794.76	165.13**
Within Groups	934.72	86	10.87	
Total	4524.25	88		

** = Significant at 0.01 level

Table 5 shows that the F value was significant (F= 165.13) at the 0.01 level. This shows that there was a significant difference between the groups. The Post-hoc analysis between the groups was conducted using Bonferroni. The results are indicated below.

Table 6 shows the post-hoc analysis for significant differences between groups on Depression. The analysis using Bonferroni indicated that there was a significant difference in the means of the Experimental group -1 and Experimental group -2 (Mean Difference = - 10.23, SE = 0.85). There were significant differences between the Experimental Group1 and Control Group (Mean Difference= -15.28, SE= 0.86); Experimental group -2 and Experimental group -1 (Mean Difference= 10.23, SE= 0.85), and the Control Group (Mean Difference= -5.05, SE= 0.86); Control Group and Experimental group -1 (Mean Difference= 15.28, SE= 0.86) and the Experimental group -2 (Mean difference= 5.05, SE= 0.86).

Table 6. Post-hoc Analysis between groups for Depression

(I) Depression	(J) Depression	Mean Difference (I-J)	Standard Error	Significance
Experimental group -1	Experimental group -2	-10.23*	0.85	.000
	Control Group	-15.28*	0.86	.000
Experimental group -2	Experimental group -1	10.23*	0.85	.000
	Control Group	-5.05*	0.86	.000
Control Group	Experimental group -1	15.28*	0.86	.000
	Experimental group -2	5.05*	0.86	.000

ANOVA test was also done to analyze the significant difference between the three groups on Loneliness.

Table 7. Mean and Standard Deviation for Experimental group -1, Experimental group - 2 and Control Group on Loneliness

Groups	N	Mean	Standard Deviation
Experimental group -1	30	38.20	10.32
Experimental group -2	30	47.73	9.41
Control Group	29	56.24	12.33

Table 7 indicates that Mean and Standard Deviation for After Intervention scores of the Experimental group -1, that is the C. A. R. E Intervention group had the least level of Depression among the three groups.

Table 8 shows that the F value is significant (F= 20.86), which is significant at the 0.01 level. This shows that there is a significant difference between the groups. The Post-hoc analysis between the groups was conducted using Bonferroni. The results are indicated below.

Table 8. ANOVA for significant difference between groups on Loneliness

	Sum of Squares	df	Mean Square	F
Between Groups	4808.43	2	2404.21	20.86**
Within Groups	9913.98	86	115.28	
Total	14722.40	88		

** = Significant at 0.01 level

Table 9. Post-hoc Analysis between groups for Loneliness

(I) Loneliness	(J) Loneliness	Mean Difference (I-J)	Standard Error	Significance
Experimental group -1	Experimental group -2	-9.53*	2.77	.003
	Control Group	-18.04*	2.79	.000
Experimental group -2	Experimental group -1	9.53*	2.77	.003
	Control Group	-8.51*	2.79	.009
Control Group	Experimental group -1	18.04*	2.79	.000
	Experimental group -2	8.51*	2.79	.009

Table 6 shows the post-hoc analysis for significant difference between groups on Loneliness. The analysis using Bonferroni indicates that there is a significant difference in the means of the Experimental group -1 and Experimental group -2 (Mean Difference = -9.53, SE = 2.77). There is a significant difference between the Experimental Group 1 and Control Group (Mean Difference = -18.04, SE = 2.79). There is a significant difference between the Experimental group -2 and Experimental group -1 (Mean Difference = 9.53, SE = 2.77), and the Control Group (Mean Difference = -8.51, SE = 2.79). There is a significant difference between the Control Group and Experimental group -1

(Mean Difference = 18.04, SE = 2.79) and the Experimental group -2 (Mean difference = 8.51, SE = 2.79).

As can be seen from the above tabulations and figures the levels of Depression and Loneliness of the Experimental group -1 (C. A. R. E Intervention) showed significantly lower levels in the After Intervention phase when compared to the Experimental group -2 (Woebot App) and the Control Group.

Hence the Hypothesis, "There will not be a significant difference between the Experimental group -1 (C. A. R. E Intervention), Experimental group -2 (Woebot App) and the Wait List Control Group (No intervention) in the post-test phase" is rejected.

Discussion

The present study shows that the positive-psychology-based intervention is highly effective in reducing the psychological issues such as loneliness and depression, at the same time building positive psychology constructs and promoting well-being within an individual. Wang et al., (2023) in their study report that psychological distress in the major risk factor for those with after COVID symptoms, to further develop depression and further health issues which may require hospitalization. They recommend that psychological distress be reduced using simple psychological interventions to build optimism and hope to reduce the risk of worsening symptoms and subsequent hospitalization. Supportive studies of positive psychology interventions being effective for reducing negative psychological constructs were also reported by Davidson et al, (2022) who demonstrated the evidence of positive affect as being a protective factor against loneliness in older adults. A meta-analysis on the effect of positive psychology interventions for treatment of depression was conducted by Pan, et al., (2022), where it was reported

that positive psychology interventions focusing on gratitude, optimism and such other positive psychology constructs can improve the affordability and accessibility of depression treatments. Also, long term benefits were reported by many studies that were incorporated in this meta-analysis. A cross-sectional study also among older adults by Alhalaseh et al., (2022) reported that those older adults who were infected by COVID and hence faced social isolation were at high risk to develop Depression. This study recommends easy to use interventions that would bring bursts of positivity in the participants to avoid the ill effects of loneliness and depression. Depression and loneliness were found to be often influenced by negative affect. This was reported by Isik et al., (2021). This study also recommends use of many psychological interventions especially interventions helping to build optimism, hope and gratitude that can reduce the risk in those vulnerable to develop depression and loneliness. Also, a similar study by Chen and Schulz,(2016) reported that social media communication based positive interventions were very effective in managing social isolation-based loneliness. This study used app-based interventions to help overcome loneliness. The same authors also recommend use of face-to-face psychological interventions for isolation. The above supportive studies sufficiently demonstrate the effectiveness of face-to face conducted positive psychology interventions to overcome psychological issues such as depression and loneliness. Also many of the studies like this study report overall well-being of the participants.

Implications

The present study had limited number of participants. Further research can use a greater number of participants and hence generalize findings further. Also, the study had participants in the age group of 20 to 35 years. Further studies with participants from

different age groups using the C. A. R. E Intervention can further establish the effectiveness of the intervention beyond doubt. The study uses a novel and easy to use intervention that can be easily imparted through virtual or offline modes and can be used widely among all populations such as students, adults, older adults, hospitalized populations etc., to bring wholesome well-being.

Conclusion

The following conclusions can be drawn from the study on “A Virtual Positive Psychology Based Intervention for Loneliness and Depression during the Pandemic”: There was a significant difference in the levels of Loneliness and Depression in the Before and After Intervention phases of both the Experimental Groups, and the C. A. R. E intervention was more effective in reducing the levels of Loneliness and Depression of the COVID sufferers than the Woebot app. Overall, it can be concluded that the C. A. R. E intervention is very effective in dealing with some of the mental health issues connected with the COVID pandemic such as Loneliness and Depression.

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