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Effectiveness of Neurobic Exercise Program on Mild to Moderate Psychological Distress Among Community-Dwelling Older Adults: A Single-Group Experimental Study

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Abstract

Background: Psychological distress affects the mental well-being of older adults and may be associated with factors such as social isolation, health problems, and significant life changes. Neurobic exercises involve novel, non-routine activities that engage multiple sensory modalities and may provide cognitive and psychological stimulation. Previous research has suggested potential benefits of neurobic exercise on cognitive and psychological outcomes among older adults. However, evidence regarding its effect on psychological distress among community-dwelling older adults remains limited. Therefore, the present study investigated the effect of a neurobic exercise program on psychological distress among community-dwelling older adults. **Methods:** A non-randomised, single-group pre-test-post-test experimental study was conducted using convenience sampling. Fifty-five community-dwelling older adults aged 60-80 years who met the eligibility criteria and had mild to moderate psychological distress were included in the study. Psychological distress was assessed using the Kessler Psychological Distress Scale (K10) before the intervention. Participants underwent a neurobic exercise program once every two days for four weeks, with each session lasting 60 minutes. Following completion of the intervention, psychological distress was reassessed using the K10. **Results:** The mean K10 score decreased from 25.98 ± 2.42 at pre-test to 22.66 ± 3.28 at post-test. The difference between pre-test and post-test K10 scores was statistically significant ($t = 10.83$, $p < 0.001$). The proportion of participants classified as having moderate psychological distress decreased from 76.4% at pre-test to 25.5% at post-test, while the proportion classified as having mild psychological distress increased from 23.6% to 60.0%. **Conclusion:** A four-week neurobic exercise program was associated with a statistically significant reduction in psychological distress among community-dwelling older adults with mild to moderate psychological distress. Further randomised controlled studies with larger samples and longer follow-up are required to determine the effectiveness and long-term effects of neurobic exercise on psychological distress.

Major Findings: A significant reduction in psychological distress was observed following the four-week neurobic exercise program ($p < 0.001$). The mean K10 score decreased from 25.98 to 22.66, with a large paired effect size (Cohen's $d_z = 1.46$). Following the intervention, the proportion of participants with mild psychological distress increased from 23.6% at baseline to 60.0% post-intervention, while the proportion with moderate psychological distress decreased from 76.4% to 25.5%

Keywords: Community-Dwelling, Experimental Study, Neurobic Exercises, Old-Aged Adults, Psychological Distress

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1. Introduction

Psychological distress is defined as a state of emotional distress characterised by symptoms of depression, such as loss of interest, sadness and hopelessness, along with anxiety, tension and despair[1]. According to Wheaton, psychological distress can be considered an emotional disturbance that affects an individual's social functioning and daily life. It may remain moderately stable over time and is not always a temporary phenomenon. If it persists, it may contribute to more serious emotional difficulties, including anxiety and depression[2]. Psychological distress can also be distinguished from specific psychiatric disorders, although prolonged exposure to stressful circumstances can have an important influence on emotional well-being[3].

The course of psychological distress is not completely understood. Factors such as retirement, bereavement, physical decline and age-related changes in cognitive functioning can contribute to mental health problems such as depression, anxiety and loneliness among older adults. Psychological distress can be assessed using standardised scales; however, psychological distress in later life remains comparatively under-researched in India. Psychological problems in older adults may develop when stressful events and difficulties exceed an individual's ability to cope effectively. When problems accumulate, and coping resources become insufficient, individuals may experience anxiety, depression, anger, restlessness and other psychological or physical symptoms[4].

Psychological distress among the elderly is an important concern in India. Previous research involving adults aged 60 years and above across Indian populations has shown a substantial burden of psychological distress and associated psychosocial problems[5]. These findings highlight the need for simple and accessible interventions that may help improve psychological well-being among community-dwelling older adults.

The term "neurobic" was introduced by Lawrence C. Katz and Manning Rubin in 1999. They proposed that mental exercises involving new and unexpected experiences could stimulate different areas and pathways of the brain and help maintain brain activity[6]. Neurobic exercise is a unique form of brain training that involves non-routine or unexpected experiences using different combinations of the physical and emotional senses. Neurobic exercises may help reduce psychological distress through several possible mechanisms. Engaging in non-routine activities may stimulate neuroplasticity by activating different neural pathways. Novel and emotionally engaging activities may also influence mood and stress. Previous studies have investigated neurobic exercises for improving memory and cognitive functioning among older adults[7].

Neurobic exercises are also believed to stimulate neurotrophic activity. Neurotrophins are proteins involved in neuronal survival, development and differentiation. They contribute to neuronal growth, nerve-fibre branching and the maintenance of neural connections. Novel and stimulating experiences may therefore support neuronal activity and brain function[8].

Among the known neurotrophins, Brain-Derived Neurotrophic Factor (BDNF) is one of the most widely distributed neurotrophic growth factors in the central nervous system. BDNF is found in areas of the brain such as the hippocampus and prefrontal cortex, which are important for learning, memory and emotional regulation. It contributes to neuronal survival, connectivity and plasticity. Alterations in BDNF have also been associated with depression and psychological distress[9].

Lin *et al*. reported that BDNF may play an important role in depression and anxiety and suggested that the BDNF gene may be involved in modulating psychological distress in the general population[10]. Other evidence has demonstrated altered BDNF expression in brain regions associated with mood and emotional regulation, further supporting a relationship between neurotrophic mechanisms and psychological health[11].

Current research suggests that neurobic exercise may have beneficial effects on cognitive and psychological outcomes. Neurobic exercise training has been associated with improvements in cognitive function and BDNF levels among older adults[8]. Studies have also reported improvements in memory following structured neurobic exercise programs among community-dwelling older adults[12]. In addition, neurobic exercise programs have demonstrated beneficial effects on depression and memory among elderly individuals[13].

However, despite the reported benefits of neurobic exercise on cognitive function, memory, and selected psychological outcomes, limited evidence is available regarding its effect on psychological distress among community-dwelling older adults. Therefore, the present study aimed to investigate the effect of a four-week

neurobic exercise program on psychological distress among community-dwelling older adults with mild to moderate psychological distress.

2. Methodology

2.1 Study Design and Participants

A non-randomised, single-group pre-test–post-test experimental study was conducted among community-dwelling older adults using a convenience sampling technique. A total of 65 individuals were initially screened for eligibility. Following the application of predefined inclusion and exclusion criteria, 55 participants aged 60–80 years with mild to moderate psychological distress were enrolled in the study.

The eligible participants underwent baseline assessment using the Kessler Psychological Distress Scale (K10). Subsequently, they participated in a four-week neurobic exercise program administered once every two days, with each session lasting approximately 60 minutes. Following completion of the intervention, psychological distress was reassessed using the same outcome measure. The pre-test and post-test scores were compared to determine changes in psychological distress following the intervention.

Ethical clearance was obtained from the Institutional Ethics Committee of Dayananda Sagar University before commencement of the study (Ethical Clearance No.: IEC/IRB/DSU/MPT/2023/029). The study was conducted in accordance with the ethical principles for research involving human participants. Written informed consent was obtained from all participants after explaining the purpose, procedures, potential benefits, and safety precautions associated with the study.

2.2 Inclusion and Exclusion Criteria

Participants aged 60–80 years who were community-dwelling, had mild to moderate psychological distress based on the Kessler Psychological Distress Scale (K10), were able to understand and follow instructions, and provided written informed consent were included in the study. Individuals with severe cognitive, neurological, psychiatric, sensory, or medical conditions that could interfere with participation in the intervention or outcome assessment, as well as those unable to complete the intervention or post-intervention assessment, were excluded.

2.3 Neurobic Exercise Intervention

The neurobic exercise program consisted of novel and non-routine activities designed to engage multiple sensory modalities. Activities involving sight, hearing, smell, taste, touch, and emotionally engaging experiences were incorporated into the program, with two or more sensory modalities combined during selected activities[6].

The intervention included the following activities:

- **Sight:** Performing selected activities with the eyes closed, such as recognising familiar objects through other sensory cues and identifying body language.
- **Hearing:** Listening to music and participating in activities involving auditory recognition and attention.
- **Smell:** Identifying familiar aromas, essential oils, herbs, fruits, flowers, and other commonly encountered substances, including lemongrass, garlic, red onion, lime, mango, rose, jasmine, and coffee.
- **Taste:** Identifying or differentiating selected tastes using items such as lime, sugar, salt, coffee, tea, and cookies.
- **Touch:** Identifying and manipulating familiar objects through tactile perception, including coins, spoons, glasses, pens, rulers, combs, and toothbrushes. Clay-modelling activities were also incorporated.
- **Emotionally engaging activities:** Activities such as playing cards, listening to music, and combining sensory experiences with emotionally engaging tasks were included[6].

Participants were also encouraged to incorporate neurobic principles into selected routine daily activities, including:

- Brushing the teeth using the non-dominant hand.
- Writing, combing, or eating using the non-dominant hand.
- Altering the usual sequence of routine activities, such as having dinner before taking a shower.
- Changing the usual place of sitting or eating.

The neurobic exercise program was administered by the researcher once every two days for four consecutive weeks. Each supervised session lasted approximately 60 minutes[14]. The sessions were conducted individually under the supervision of the researcher. Each participant performed the prescribed sensory-based activities according to the structured intervention protocol. The same planned activities and session duration were followed throughout the intervention period.

2.4 Outcome Measure

2.4.1 Kessler Psychological Distress Scale (K10)

The Kessler Psychological Distress Scale (K10) was used as the primary outcome measure to assess psychological distress. The K10 is a 10-item self-report questionnaire designed to measure non-specific psychological distress experienced over the preceding four weeks. Each item is rated on a five-point response scale, producing a total score ranging from 10 to 50, with higher scores indicating greater psychological distress. The participants were classified according to the standard K10 scoring categories: scores of 10–19 indicated likely to be well, 20–24 indicated mild psychological distress, 25–29 indicated moderate psychological distress, and 30–50 indicated severe psychological distress. Participants with mild to moderate psychological distress (K10 scores of 20–29) at baseline were included in the study. Following the four-week neurobic exercise intervention, participants were reassessed using the same scale to evaluate changes in psychological distress[14]. As the study employed a single-group pre-test–post-test design, assessor blinding was not implemented. Therefore, the possibility of assessment-related bias cannot be excluded.

2.5 Statistical Analysis

Data were analysed using IBM SPSS Statistics version 29.0. Descriptive statistics were used to summarise participant characteristics and psychological distress scores. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages. Pre-test and post-test Kessler Psychological Distress Scale (K10) scores were compared using a paired-samples *t*-test. The distribution of participants across the predefined K10 psychological distress categories at pre-test and post-test was summarised using frequencies and percentages. A *p*-value of less than 0.05 was considered statistically significant. Effect sizes were calculated using Cohen's dz for the paired-samples t-test and pooled-standard-deviation Cohen's d for independent-samples gender comparisons. The 95% confidence interval for the mean difference in K10 scores was also estimated.

3. Results

Figure 2 denotes the significant reduction in the number of participants with moderate psychological distress from 76.4% to 25.5% and a substantial increase in the number of participants with mild psychological distress from 23.6% to 60%.

Figure 3 illustrates the comparison of mean K10 psychological distress scores before and after the four-week neurobic exercise intervention. A reduction in the mean K10 score was observed from pre-test to post-test.

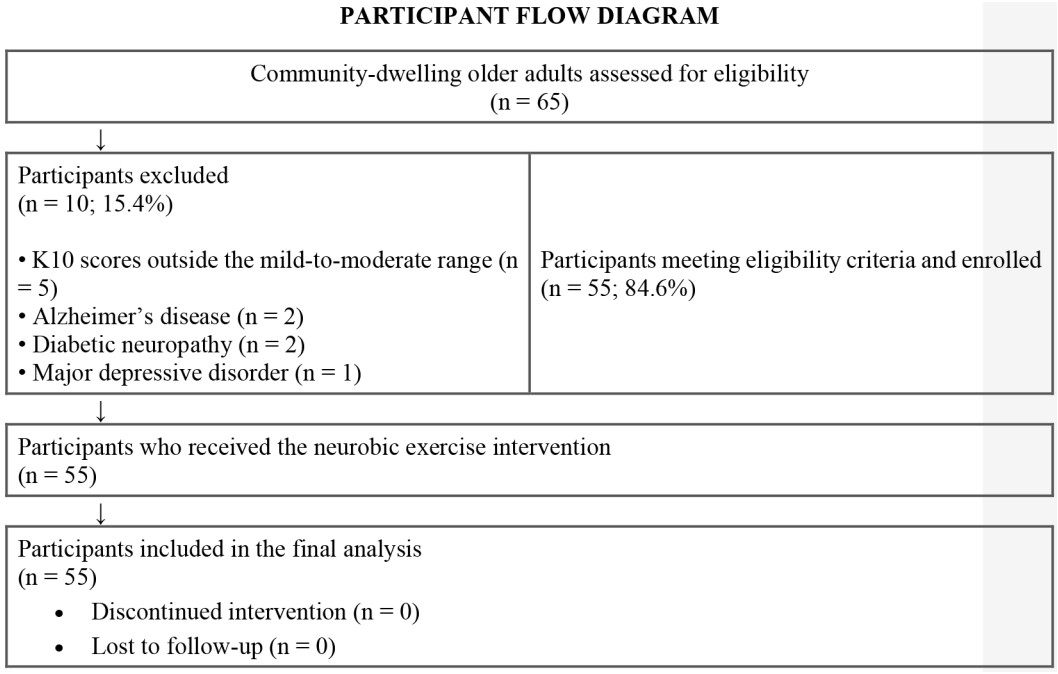

Figure 1. Participant flow diagram showing screening, exclusion, enrolment, intervention, and analysis.

Table 1. Gender distribution of study participants (N = 55)

Gender	Frequency (n)	Percentage (%)
Male	25	45.5
Female	30	54.5

Interpretation: Of the 55 participants, 30 (54.5%) were female and 25 (45.5%) were male. Females constituted a slightly higher proportion of the study population.

Table 2. Distribution of participants according to K10 psychological distress classification at pre-test and post-test (N = 55)

Psychological Distress Category	Pre-test, n (%)	Post-test, n (%)
Mild	13 (23.6)	33 (60.0)
Moderate	42 (76.4)	14 (25.5)
Likely to be well	0 (0.0)	8 (14.5)

Interpretation: At pre-test, most participants (76.4%) were classified as having moderate psychological distress, while 23.6% had mild psychological distress. At post-test, the proportion with moderate distress decreased to 25.5%, whereas the proportion with mild distress increased to 60.0%. Additionally, 14.5% of participants were classified as likely to be well.

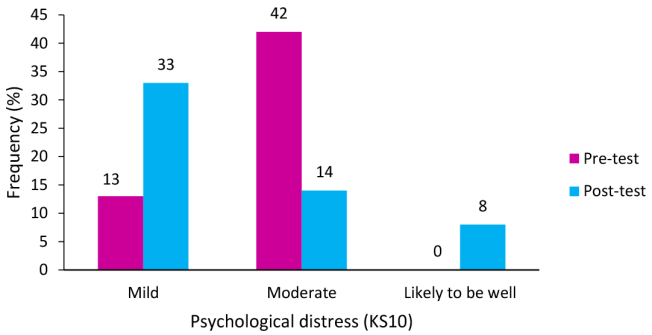

Figure 2. Assessment of psychological distress.

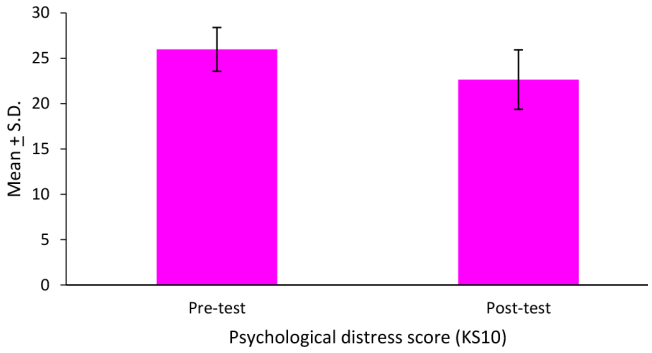

Figure 3. Psychological distress score.

Table 3. Comparison of K10 psychological distress scores according to gender at pre-test and post-test

Assessment	Gender	Mean	SD	t	p-value	Cohen's d
Pre-test	Male	26.08	2.40	0.27	0.786	0.07
	Female	25.90	2.47			
Post-test	Male	22.52	3.65	−0.28	0.784	−0.08
	Female	22.77	2.99			

Test used: Independent-samples t-test. SD = standard deviation.

Interpretation: At pre-test, the mean K10 score was 26.08 ± 2.40 among males and 25.90 ± 2.47 among females. At post-test, the corresponding mean scores were 22.52 ± 3.65 and 22.77 ± 2.99, respectively. Independent-samples t-tests revealed no statistically significant differences between males and females at pre-test (t = 0.27, p = 0.786) or post-test (t = −0.28, p = 0.784). The corresponding Cohen's d values were 0.07 and −0.08, indicating negligible gender differences in psychological distress scores at both assessment points.

Table 4. Pre- to post-test comparison of psychological distress (K10)

		Mean	S.D.	Mean Difference	95% CI	"t"	p value	Cohen's dz
K10	Pre-test	25.98	2.42	3.33	2.71–3.95	10.83	< 0.001*	1.46
	Post-test	22.66	3.28					

The mean K10 psychological distress score decreased from 25.98 ± 2.42 at pre-test to 22.66 ± 3.28 at post-test. The paired-samples t-test demonstrated a statistically significant reduction in psychological distress following the four-week neurobic exercise intervention (t = 10.83, p < 0.001). The post-test standard deviation was higher than the pre-test standard deviation, indicating increased variability in participants' post-intervention scores.

The paired-samples t-test demonstrated a statistically significant difference between the two assessment periods ($t = 10.83$, $p < 0.001$).

4. Discussion

The present study aimed to evaluate the effectiveness of a neurobic exercise program in reducing mild to moderate psychological distress among community-dwelling older adults. The findings showed a significant reduction in psychological distress following four weeks of neurobic exercise. The improvement observed in the present study supports the concept that novel and stimulating activities may have beneficial effects on cognitive and psychological well-being.

The results are consistent with previous research suggesting that neurobic exercises may improve brain function by stimulating different neural pathways and encouraging the formation of new neural connections. Neurobic activities involve unfamiliar and multisensory experiences, which may promote cognitive stimulation and neuroplasticity.

In the present study, psychological distress was assessed using the Kessler Psychological Distress Scale (K10). Previous research has demonstrated the usefulness of the K10 as a screening measure for psychological distress[14].

Other studies have shown similar benefits of neurobic exercise. Research involving individuals with cognitive impairment has reported improvements following neurobic exercise programs, further supporting their potential role as a simple non-pharmacological intervention[15]. Neurobic training has also been reported to improve cognitive performance through activities that challenge normal patterns of brain activity[16].

In the present study, pre- and post-test scores on the Kessler Psychological Distress Scale (K10) showed a clear improvement following the intervention. The mean K10 score decreased from 25.98 ± 2.42 in the pre-test to 22.66 ± 3.28 in the post-test. The t value of 10.83, with a p-value <0.001, indicates that the difference between the pre-test and post-test scores was statistically significant. The psychometric properties of the K10 have also been examined in different populations, further supporting its use for the assessment of psychological distress[17].

The distribution of psychological distress also improved after the intervention. Before the intervention, 23.6% of participants had mild psychological distress and 76.4% had moderate psychological distress. Following four weeks of neurobic exercise, 60% were classified as having mild psychological distress, 25.5% had moderate psychological distress, and 14.5% were classified as likely to be well. These findings demonstrate an overall reduction in psychological distress among the participants.

The significant reduction in psychological distress observed in the present study, together with previous findings regarding neurobic exercise, suggests that participating in novel and stimulating activities may contribute to better psychological well-being by encouraging cognitive stimulation and neuroplasticity.

The magnitude of the observed improvement was further supported by the effect size analysis. The paired-samples effect size (Cohen's dz) was 1.46, indicating a large standardised effect of the intervention on psychological distress scores. The mean reduction in K10 scores was approximately 3.33 points, with an estimated 95% confidence interval of 2.71–3.95 points. However, the clinical significance and long-term sustainability of this improvement require further investigation through controlled studies with longer follow-up periods.

The positive findings of the present study also have implications for clinical practice. Neurobic exercises are simple and can be incorporated into physiotherapy and mental health programs for older adults. They require minimal equipment and can be included in routine daily activities, making them an accessible and affordable approach for community-dwelling older adults.

The study also highlights the importance of addressing psychological distress in older adults, who may experience fewer opportunities for cognitive stimulation and social interaction. Neurobic exercises may provide a practical non-pharmacological approach for promoting cognitive activity and psychological well-being. However, further research is required to determine their long-term effectiveness and to evaluate their effects in larger populations.

5. Limitations

The single-group pre-test–post-test design without a control group limits the ability to establish a direct causal relationship between the neurobic exercise intervention and the observed reduction in psychological distress. Convenience sampling and the relatively small sample size may limit the generalisability of the findings to the wider older adult population. Additionally, the four-week

intervention period and absence of follow-up assessments prevented evaluation of the long-term sustainability of the observed improvements. Psychological distress was assessed using a self-reported questionnaire, which may be influenced by individual perceptions and response bias. Furthermore, the potential influence of researcher attention, individual researcher-participant interaction, participant motivation, and engagement on the observed reduction in psychological distress could not be independently controlled. These factors may have contributed to the observed improvements, and their influence cannot be separated from the intervention effects due to the absence of a control group.

6. Recommendations

Future studies should employ randomised controlled trial designs with larger and more diverse populations to establish the effectiveness of neurobic exercise in reducing psychological distress among older adults. Longer intervention periods and follow-up assessments are recommended to evaluate the sustainability of improvements over time. Further studies should also compare neurobic exercises with other established interventions and consider controlling for factors such as researcher attention and participant engagement to determine the specific contribution of neurobic exercise to psychological well-being.

7. Conclusion

A significant reduction in psychological distress was observed following a four-week neurobic exercise intervention, as demonstrated by the pre- and post-test scores on the Kessler Psychological Distress Scale (K10). These findings suggest that neurobic exercises may be an accessible approach to promote psychological well-being among older adults. Future research should include larger sample sizes, randomised controlled designs, and longer follow-up periods to establish the effectiveness and long-term benefits of neurobic exercises.

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Author Contribution

Pragnya Jahnavi: Conceptualisation, Methodology, Investigation, Data Collection, Formal Analysis, and Writing – Original Draft. Sunjyoth H.S: Supervision, Methodology, Validation, and Writing – Review and Editing. Siddesh Ganesan: Methodology, Data Interpretation, Validation, and Writing – Review and Editing. Vaishnavi Joshi: Validation and Writing – Review and Editing.

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