Revista Mexicana de Neurociencia

PERMANYER

Check for updates

ORIGINAL ARTICLE

Prospective memory assessment in a Mexican sample with depression

Derian Mandujano-Torres[1], Georgina Cardenas-López[1], Azzizudin Khan[2], and Raúl Durón-Figueroa[1]*

[1]Universidad Nacional Autónoma de México, México City, Mexico; [2]Indian Institute of Technology Bombay, Bombay, India

Abstract

Objective: *To evaluate deficits in time-based and event-based prospective memory (PM) in Mexican individuals diagnosed with moderate to severe depression.* **Methods:** *Two PM paradigms and a high cognitive load task were administered to 22 participants (with and without depression). Performance in time-based and event-based tasks was compared using screen click frequency as an indicator of errors and overall performance.* **Results:** *Differences were found in event-based task performance compared to time-based tasks across both groups. Participants achieved an overall average score of 64.67 (SD = 15.45). No significant differences were found between conditions, except for a marginal effect observed in Task 6 ($p = 0.049$).* **Conclusions:** *These findings suggest variations in PM execution under cognitive load. However, the marginal statistical significance highlights the need for further studies with larger samples to obtain more robust data on cognitive impairment in this population.*

Keywords: *Depression. Prospective memory. Cognition. Time.*

Evaluación de la memoria prospectiva en una muestra mexicana con depresión

Resumen

Objetivo: *Evaluar los déficits en la memoria prospectiva (MP) basada en tiempo y eventos en individuos mexicanos con diagnóstico de depresión moderada a severa.* **Métodos:** *Se administraron dos paradigmas de MP y una tarea de alta carga cognitiva a 22 participantes (con y sin depresión). Se comparó el desempeño en tareas basadas en tiempo y en eventos utilizando la frecuencia de clics en pantalla como indicador de error y rendimiento.* **Resultados:** *Se identificaron diferencias en el desempeño de las tareas basadas en eventos en comparación con las de tiempo en ambos grupos. Los participantes obtuvieron una puntuación promedio general de 64.67 (DE = 15.45). No se hallaron diferencias significativas entre condiciones, a excepción de un efecto marginal observado en la Tarea 6 ($p = 0.049$).* **Conclusiones:** *Los hallazgos sugieren variaciones en la ejecución de la MP bajo condiciones de carga cognitiva, aunque la sutil diferencia estadística subraya la necesidad de estudios con muestras más amplias para obtener datos más robustos sobre el deterioro cognitivo en la población afectada.*

Palabras clave: *Depresión. Memoria prospectiva. Cognición. Temporalidad.*

***Correspondence:**
Derian Mandujano-Torres
E-mail: deriantorres@outlook.es

Date of reception: 24-02-2025
Date of acceptance: 18-11-2025
DOI: 10.24875/RMN.25000010

Available online: 25-02-2026
Rev Mex Neuroci. 2026;27(1):3-9
www.revmexneurociencia.com

Introduction

Depression is the most prevalent mood disorder worldwide and one of the most common mental health conditions. It affects over 350 million people globally, with higher prevalence among women and individuals from lower socioeconomic backgrounds[1]. According to the Diagnostic and Statistical Manual of Mental Disorders[2], depression is characterized by persistent sadness, anhedonia, hopelessness, low self-esteem, and suicidal ideation, which must persist for at least 2 weeks for a clinical diagnosis[3,4]. These symptoms often coincide with cognitive impairments, including reduced flexibility and diminished executive functioning.

The etiology of depression involves genetic, epigenetic, and environmental factors that impact brain biochemistry and neural functioning. These changes can affect cognition, appetite, libido, and sleep, ultimately reducing individuals' quality of life and daily functioning[5]. Cognitive deficits in depression include impairments in psychomotor speed, attention, memory, and executive functions such as inhibition, motivation, and working memory. Neuroimaging studies report alterations in fronto-thalamic and limbic-frontal circuits[6], which tend to worsen with recurrent episodes, although partial cognitive recovery is observed during remission.

A key cognitive function affected by depression is prospective memory (PM) – the ability to remember and execute intended actions in the future. PM failures negatively impact daily functioning and emotional well-being. PM is typically divided into two subtypes: event-based PM (EBPM), where intentions are triggered by external cues, and time-based PM (TBPM), which relies on self-initiated processes to act at a specific time[7-12]. TBPM is considered more cognitively demanding, especially under high cognitive load, and particularly sensitive to impairments in attention and executive control[13-17]. Studies have shown that individuals with depression exhibit deficits in both types of PM, with TBPM being more affected[18-25].

Recent findings suggest that increased cognitive load further impairs PM performance, especially in TBPM tasks that require sustained monitoring and self-regulation[26]. However, little research has explored these effects in clinical populations within Latin America.

Given previous findings and the relevance of PM in everyday functioning, the present study aimed to compare time-based and EBPM performance between individuals with depression and non-clinical controls. We hypothesized that the depression group (DG) would show significantly poorer performance in both PM types, with greater impairment in TBPM tasks due to their higher cognitive demands.

Objective

The objective of the study is to compare PM performance in Mexican patients with depression and a control group (CG) of non-clinical individuals.

Methods

Participants

The final sample included 22 participants aged 18-29 years (M = 22.96, standard deviation [SD] = 4.95), divided into a DG (DG; n = 13) and a CG (CG; n = 9). All participants had at least 8 years of education. The DG consisted of individuals with beck depression inventory (BDI) scores above 24, while the CG included participants with BDI scores below 24 and no history of depressive episodes, either current or remitted. Individuals undergoing pharmacological treatment or with a history of psychiatric or neurological conditions were excluded from both groups.

Although the inclusion criteria for the DG allowed for participants up to 65 years of age, the oldest participant included was 47, whereas in the CG, the maximum age was 26. This discrepancy in age ranges was not intentional but rather a consequence of the recruitment process. Nevertheless, all participants fell within the young adult range, minimizing the likelihood of age-related cognitive variability.

The severity of depression in the clinical group was classified as either mild or moderate. None of the participants in the DG were undergoing pharmacological treatment, psychotherapy, or any other form of intervention that could potentially influence memory performance.

Both groups were randomly assigned to two experimental conditions using the Pinetools software (Table 1).

Instruments and experimental paradigms

BDI[27,28]

This inventory assesses depressive symptoms through 21 items, divided into two factors: affective-cognitive and vegetative-somatic. It uses a Likert-type scale ranging from 0 to 3, where 0 indicates no symptoms and 3 indicates severe symptoms. The version

Table 1. Number of participants by group and condition

DG		CG	
EEPM	TBPM	EEPM	TBPM
6	6	7	6

EBPM: event-based prospective memory condition; TBPM: time-based prospective memory; DG: depression group; CG: control group.

adapted for the Mexican population (Jurado et al., 1998) has a Cronbach's Alpha of 0.94, ensuring high reliability.

TBPM and EBPM experimental paradigm[26]

This 30-min paradigm consists of 120 multiple-choice general knowledge questions, with 15 s to respond to each. If a response is not provided within the allotted time, the question automatically advances. Simultaneously, the PM task is carried out under two conditions:

- EBPM: when the words "coin," "planet," or "state" appeared, participants had to click on the right side of the screen.
- TBPM: participants had to click on the right side of the screen every 5 min, with a clock placed nearby to assist them.

High cognitive load task (QUEST1; Khan, 2007)

This task consists of 120 multiple-choice general knowledge questions, with a response time of 10 s per question. Unanswered questions were recorded as omissions. This task served as a distractor to assess PM under high cognitive load.

Procedure

Participants were voluntarily recruited through social media. After explaining the study's objective, they received an informed consent form, followed by an interview and BDI administration. Based on the BDI results and the interview, participants were assigned to one of two groups: the DG or the CG. Random assignment to experimental conditions was conducted using Pinetools.

Experimental sessions lasted between 45 min and 1 h, conducted in a closed, well-lit, and ventilated room. Participants used an HP laptop with the necessary software installed, while the evaluator positioned themselves at a 135° angle from the participant.

Description of each paradigm

Time-based task

In this paradigm, participants had to respond to six temporal stimuli by pressing the screen exactly every 5 min. A clock was placed near the participants, but they were explicitly instructed to avoid looking at it. Simultaneously, 120 general knowledge questions were presented to distract the participant and make it harder to accurately perceive the passage of time.

The QUEST1 task was administered simultaneously with the PM tasks. It was an independent task that participants performed in parallel to the main PM activities.

Event-based task

This task followed a similar structure, with 120 general knowledge questions presented. However, in this case, participants had to click on the right side of the screen whenever the words "coin," "planet," or "country" appeared in either the question or response options. It is important to note that only these specific words were relevant, and their occurrence was programmed to appear approximately every 5 min, similar to the time-based task.

Statistical analysis

SPSS V.27 was used to calculate response frequencies by condition and to analyze sociodemographic data. Due to the non-parametric nature of the data, two statistical tests were applied: the Kruskal-Wallis test and the Mann-Whitney U test, to examine differences between conditions.

Results

The descriptive and inferential results are summarized in tables 1-5. Table 1 outlines the distribution of participants across experimental groups and task conditions, showing a relatively balanced allocation. Tables 2 and 3 provide sociodemographic data, confirming that the overall sample consisted primarily of young adults, with no extreme demographic disparities between groups. In table 4, the Kruskal-Wallis test revealed no statistically significant differences across

Table 2. General sample sociodemographic data

Data	Age	Sex	Occupation	Marital status	Total score
Total	M = 22.96 SD = 4.95	F = 18 M = 7	Student = 11 Graduate = 8 Employee = 6	Single = 19 In a relationship = 6	M = 64.67 SD = 15.45

M: mean; SD: standard deviation.

Table 3. Sociodemographic data by group

Data	No depression (n = 13)				With depression (n = 12)			
	Minimum	Maximum	Mean	Standard deviation	Minimum	Maximum	Mean	Standard deviation
Age	18	47	23.15	7.4	18	26	22.75	2.09
BDI	2	13	7.76	3.63	16	50	27.16	9.33

BDI: beck depression inventory score.

Table 4. Kruskal-Wallis test for independent samples by condition

Items	Significance
Correct click 1	0.252
Correct click 2	0.488
Correct click 3	0.126
Correct click 4	0.126
Correct click 5	0.583
Correct click 6	0.049

Table 5. Mann-Whitney U test for independent samples by population

Items	Significance
Correct click 1	0.728
Correct click 2	0.689
Correct click 3	0.810
Correct click 4	0.810
Correct click 5	0.980
Correct click 6	0.936

conditions for most items, except for Task 6, which yielded a marginally significant result (p = 0.049). Table 5 presents the Mann-Whitney U test results comparing the depressed and non-depressed groups directly, where no significant differences were found for any task item. Together, these results suggest a general consistency in performance across groups and conditions, with only a slight deviation observed in one task that may warrant further exploration.

The sample primarily consisted of females aged 18-27, with a mean age of 22.96 years (SD = 4.95). Most participants were students and single. As shown in table 1, the total sample included 22 participants with a mean age of 22.96 years (SD = 4.95). Of these, 18 were women and 7 were men. Regarding occupation, 11 were students, 8 were recent graduates, and 6 were employed. In terms of marital status, 19 were single, and 6 were in a relationship. The average total score was 64.67 (SD = 15.45). Tables 2 and 3 present the sociodemographic data based on the experimental groups.

The difference in age ranges between groups was not intentional. While our inclusion criteria allowed for participants up to 64 years of age, the oldest participant in the DG was 47 years old, compared to a maximum age of 26 in the CG. This discrepancy was not pre-planned but rather a result of recruitment outcomes.

Subsequently, two non-parametric statistical analyses were conducted to compare performance in PM tasks based on the Population variable (participants with and without depression) and the Condition variable (Depression + Event, Depression + Time, No Depression + Event, No Depression + Time).

The Kruskal-Wallis test (Table 3) was used to evaluate differences in performance across experimental conditions. No statistically significant differences were found in most items, except for Task 6 ($p = 0.049$), where a marginal difference was observed. Meanwhile, the Mann-Whitney U test (Table 4) compared groups at the population level, with no significant differences detected in any of the evaluated tasks. Overall, the results suggest that neither the experimental condition nor the presence of depressive symptoms significantly influenced global performance in PM tasks.

Discussion

The objective of this study was to compare the performance of individuals with and without depression in two PM conditions: time-based and event-based. The results indicate that there were no statistically significant differences in PM task performance between the experimental conditions, as all four groups exhibited similar and positive performance. Likewise, no significant differences were found between depression severity and performance in both PM conditions.

These findings are consistent with previous studies suggesting that PM impairment is not related to the severity of depressive symptoms[29-31]. However, they contrast with research on the persistence of cognitive deficits in patients with depression in remission.

Although our results suggest a trend toward lower performance in EBPM compared to TBPM, this difference was not statistically significant and should therefore be interpreted with caution. Furthermore, the presence of a visible clock during the tasks may have influenced participants' performance in the TBPM condition, potentially reducing the self-initiated monitoring demands typically associated with this paradigm. This factor represents a limitation, as it may have diminished the sensitivity of the TBPM measure.

Our comparison with Khan et al.[26] highlights important divergences that warrant further exploration. Differences in cultural context, participant characteristics, or methodological aspects – such as task design, cognitive load manipulations, or the nature of cues – could underlie the contrasting findings. For instance, the strategies employed by participants to estimate time or the presence of external timekeeping aids might vary across studies, affecting performance outcomes. Future research should consider these factors to better understand the conditions under which TBPM and EBPM differ, especially within diverse populations.

Moreover, Khan et al.[26], also reported that cognitive load (measured through the general knowledge questionnaire) had a greater impact on TBPM than on event-based memory. In contrast, in our study, questionnaire scores exceeded 65 points in the time conditions, whereas in the event conditions, most participants scored below 60. This suggests that the questionnaire did not interfere with TBPM performance, as most participants in this condition responded adequately to the tasks, particularly those with depression.

One of the main limitations of this study is the small sample size, which limits the generalizability of the results. Low participation, possibly related to the stigma associated with depression, hindered broader representation of the general population. Future research should aim to increase the number of participants and control for variables such as age and sex. Given this, replicating this study with a larger sample and in different population contexts would be highly recommended to evaluate the impact of various factors on PM.

One noteworthy finding is the marginally significant difference observed in Task 6 ($p = 0.049$). Although this result does not meet the conventional threshold for statistical significance, it may reflect an emerging pattern related to cognitive load or the structure of the task. Given the limited sample size, this result should be interpreted with caution. Nevertheless, it highlights the need for further studies with greater statistical power to determine whether this trend represents a true effect.

It should be noted that no corrections for multiple comparisons were applied in this study. This decision was made due to the exploratory nature of the research and the relatively small number of comparisons. However, this may increase the risk of Type I errors. Future studies should consider implementing correction procedures, such as Bonferroni or False Discovery Rate adjustments, to address this limitation.

Another limitation of this study lies in the lack of control over individual factors that may influence cognitive performance, such as anxiety, fatigue, or variations in circadian rhythms. Although these elements were not directly assessed, they could have had an impact on participants' execution of PM tasks. In addition, the absence of complementary assessments that could provide a broader understanding of the cognitive profile – such as measures of working memory, sustained attention, or processing speed – limits the interpretation of the specific processes involved. Including such evaluations in future research

would allow for a more nuanced analysis of the relationship between depressive symptoms and PM, as well as the executive components that underlie this function.

Conclusion

The results of this study suggest that, within the studied population, there are no significant differences in PM performance between individuals with and without depressive symptoms, nor between time-based and event-based conditions. These findings indicate that, under the current experimental conditions, the presence of depression does not appear to affect PM performance. However, given the limitations related to sample size and demographic variability, these results should be interpreted with caution. Further research with larger, more diverse samples and additional controlled variables is necessary to clarify the relationship between depression and PM functioning. Considering the impact of PM deficits on daily life and their link to executive dysfunction, incorporating PM tasks into clinical cognitive assessments may contribute to the early detection of subtle cognitive impairments and inform more targeted, functionally relevant interventions for individuals with depression.

Funding

The authors declare that this work was carried out with the authors' own resources.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical considerations

Protection of human subjects and animals. The authors declare that the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the World Medical Association and the Declaration of Helsinki. The procedures were authorized by the Institutional Ethics Committee.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from all patients, and secured approval from the Ethics Committee. SAGER guidelines have been followed as applicable to the nature of the study.

Declaration on the use of artificial intelligence (AI). The authors declare that an artificial intelligence tool was used to support the preparation of the manuscript (artificial intelligence tools, such as ChatGPT, were used solely for translation and stylistic editing purposes. The content of the manuscript is entirely original and was written by the authors).

References

1. Morales C. La depresión: un reto para toda la sociedad del que debemos hablar. Rev Cubana Salud Publica. 2017;43:136-9.
2. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5th ed. Arlington, VA: American Psychiatric Association; 2013.
3. Singkhorn O, Hamtanon P, Moonpanane K, Pitchalard K, Sunsern R, Leaungsomnapa Y, et al. Developing a depression care model for the hill tribes: a family- and community-based participatory research. Depress Res Treat. 2023;2023:3191915.
4. Madero M, Denys J, Mayancela M, Villegas E. Trastorno depresivo mayor. RECIAMUC. 2021;5:e200.
5. Cruzblanca H, Lupercio P, Collas J, Castro E. Neurobiología de la depresión mayor y de su tratamiento farmacológico. Salud Ment. 2016;39:47-58.
6. McFarland C, Vasterling J. Prospective memory in depression: review of an emerging field. Arch Clin Neuropsychol. 2018;33:912-30.
7. Ellis J, Freeman JE. Ten years on: realizing delayed intentions. In: Kliegel M, McDaniel MA, Einstein GO, editors. Prospective Memory: Cognitive, Neuroscience, Developmental, and Applied Perspectives. New York, NY: Lawrence Erlbaum Associates; 2008. p. 1-27.
8. Gordillo-León F, Arana J, Meilán JJ, Mestas L. The effect of emotion on prospective memory: a new approach based on operant procedures. Escritos Psicol. 2010;3:40-7.
9. Pink JE, Dodson CS. Negative prospective memory: remembering not to perform an action. Psychon Bull Rev. 2013;20:184-90.
10. Channon S, Baker JE, Robertson MM. Effects of structure and clustering on recall and recognition memory in clinical depression. J Abnorm Psychol. 1993;102:323-8.
11. Hertel PT. Depression and memory: are impairments remediable through attentional control? Curr Dir Psychol Sci. 1994;3:190-3.
12. Hertel PT, Hardin TS. Remembering with and without awareness in a depressed mood: evidence of deficits in initiative. J Exp Psychol Gen. 1990;119:45-59.
13. Cohen AL, Dixon RA, Lindsay DS, Masson ME. The effect of perceptual distinctiveness on the prospective and retrospective components of prospective memory in young and old adults. Can J Exp Psychol. 2003;57:274-91.
14. Gonen-Yaacovi G, Burgess PW. Prospective memory: the future for future intentions. Psychol Belg. 2012;52:173-204.
15. Jones S, Livner A, Bäckman L. Patterns of prospective and retrospective memory impairment in preclinical Alzheimer's disease. Neuropsychology. 2006;20:144-52.
16. Umeda S, Nagumo Y, Kato M. Dissociative contributions of medial temporal and frontal regions to prospective remembering. Rev Neurosci. 2006;17:267-78.
17. Wesslein AK, Rummel J, Boywitt CD. Differential effects of cue specificity and list length on the prospective and retrospective prospective-memory components. J Cogn Psychol. 2014;26:135-46.
18. Harvey PO, Fossati P, Pochon JB, Levy R, LeBastard G, Lehéricy S, et al. Cognitive control and brain resources in major depression: an fMRI study using the n-back task. Neuroimage. 2005;26:860-9.
19. Wagner G, Sinsel E, Sobanski T, Köhler S, Marinou V, Mentzel HJ, et al. Cortical inefficiency in patients with unipolar depression: an event-related fMRI study with the Stroop task. Biol Psychiatry. 2006;59:958-65.
20. Botteron KN, Raichle ME, Drevets WC, Heath AC, Todd RD. Volumetric reduction in left subgenual prefrontal cortex in early-onset depression. Biol Psychiatry. 2002;51:342-4.
21. Burgess PW, Scott SK, Frith CD. The role of the rostral frontal cortex (area 10) in prospective memory: a lateral versus medial dissociation. Neuropsychologia. 2003;41:906-18.
22. Greicius MD, Flores BH, Menon V, Glover GH, Solvason HB, Kenna HA, et al. Resting-state functional connectivity in major depression: abnormally increased contributions from subgenual cingulate cortex and thalamus. Biol Psychiatry. 2007;62:429-37.

23. Okuda J, Fujii T, Ohtake H, Tsukiura T, Yamadori A, Frith CD, et al. Differential involvement of regions of rostral prefrontal cortex (Brodmann area 10) in time- and event-based prospective memory. Int J Psychophysiol. 2007;64:233-46.
24. Zeng L, Shen H, Liu L, Wang L, Li B, Fang P, et al. Identifying major depression using whole-brain functional connectivity: a multivariate pattern analysis. Brain. 2012;135:1498-507.
25. Zhou FC, Wang YY, Zheng W, Zhang Q, Ungvari GS, Ng CH, et al. Prospective memory deficits in patients with depression: a meta-analysis. J Affect Disord. 2017;220:79-85.
26. Khan A, Sharma N, Dixit S. Cognitive load and task condition in event- and time-based prospective memory: an experimental investigation. J Psychol. 2008;142:517-31.
27. Beck A, Epstein N, Brown G, Steer R. An inventory for measuring clinical anxiety: psychometric properties. J Consult Clin Psychol. 1988;56:893-7.
28. Jurado S, Villegas M, Méndez L, Rodríguez F, Loperena V, Varela R. La estandarización del Inventario de Depresión de Beck para los residentes de la Ciudad de México. Salud Ment. 1998;21:26-31.
29. Castellanos V, Mateus S, Cáceres I, Díaz P. Caracterización de la depresión en estudiantes universitarios. SHS. 2016;3:37-48.
30. Goodall J, Fisher C, Hetrick S, Phillips S, Parrish E, Alliot K. Neurocognitive functioning in depressed young people: a systematic review and meta-analysis. Neuropsychol Rev. 2018;28:216-31.
31. Pérez E, Cervantes V, Hijuelos N, Pineda J, Salgado H. Prevalencia, causas y tratamiento de la depresión mayor. Rev Biomed. 2017;28:73-88.