ORIGINAL ARTICLE

Prevalence, Risk and Protective Factors of Mild Cognitive Impairment among Male Military Veterans in Malaysia

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ABSTRACT

Objective: **The aim of the study is to determine the prevalence of mild cognitive impairment (MCI) and its associated factors among veterans who lived in the urban city of Kuala Lumpur, Malaysia.**

Methods: **A cross-sectional study using a face-to-face interview was conducted to obtain information on sociodemographic, behavioral activities, and health-related conditions. All participants underwent cognitive tests using the Bahasa Malaysia version of the Montreal Cognitive Assessment (MoCA-BM).**

Results: **A total of 406 male veterans with a mean age of 61.5 years old participated in the study. The prevalence of MCI was 21.4%. A logistic regression model revealed that low physical activity (adjusted odds ratio (aOR) 10.29), hypertension (aOR 2.22), lower education level (aOR 2.98), subjective memory difficulty (aOR 3.61), and subjective concentration difficulty (aOR 3.95) were associated with a higher likelihood of MCI. In addition, those aged 60 years and above, as well as those in the non-officer group, were associated with a higher risk for MCI with aOR 4.57 and 4.59 respectively.**

Conclusion: **Inactivity and hypertension are preventable risk factors MCI. Therefore, military veterans must be encouraged to practice a physically active lifestyle after retirement to maintain a healthy cognitive level.**

KEY WORDS

mild cognitive impairment, risk factors, veterans

INTRODUCTION

Mild cognitive impairment (MCI) is a condition in which an individual shows cognitive decline with a minimum decrease in the instrumental activity of daily living (IADL)[1]. Globally, the prevalence rate of MCI is estimated to range from 5.0% to 36.7%[2-4]. The prevalence of MCI in Malaysia varies between 27.3% and 64.7%[3,4]. However, all the published studies on MCI focused on the civilian population of older adults. There is a lack of data on cognitive disorders among military veterans in Malaysia.

In Western countries, cognitive impairment among veterans has grown to be a significant problem in the last few decades due to frequent military deployment and engagement in warfare, such as the Gulf War and the Afghanistan War[5]. The deployment has been shown to cause significant physical and mental health issues such as traumatic brain injury (TBI) and post-traumatic stress disorder (PTSD), subsequently leading to cognitive decline[6].

Nonetheless, even if the veterans in Malaysia are not involved in active military combat, they are still at risk of developing MCI. They may be predisposed to head injury during military training, or developed mental health issues or cardiovascular diseases that later evolve into a risk for MCI. In comparison, research conducted among the Chinese military veterans discovered that sleep impairment, uncontrolled hypertension, type 2 diabetes mellitus, hypercholesterolemia, and a low education level were significantly associated with moderate cognitive impairment[7,8]. In addition, a person with MCI is at a higher risk of developing dementia[1], with the rate of transition from MCI to dementia ranging between 8% and 15% annually[1,9]. Therefore, it is crucial to identify the preventable risk factors of MCI to reverse or prevent the onset of dementia among veterans.

With these in mind, a cross-sectional study was conducted to determine the prevalence of MCI and its risk factors among male military veterans in Malaysia. This work focused exclusively on male veterans because previous research indicated that male veterans were more likely to develop cognitive impairment than females[2,8]. Furthermore, males outnumber females in the military and they are more likely to perform operational duties while in service, thus making them more susceptible to mental health risks.

METHODS

Study design and sample size

A cross-sectional study was conducted in Kuala Lumpur (KL),

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Table 1 Descriptive and bivariate analysis of the sociodemographic characteristics with mild cognitive impairment (MCI)

Characteristic	Total, N (%)	MCI, N (%)	No MCI, N (%)	P-value χ^2	Crude OR [a] (95% CI)
Participants	406	87 (21.4)	319 (78.6)	N/a	
Age group/mean (SD) year	61.5 (8.4)	68.7 (7.1)	59.5 (7.7)	< 0.001 [b]	1.20 (1.15, 1.26)
> 60 years	244 (60.1)	73 (29.9)	171 (70.1)	< 0.001	4.51 (2.45, 8.33)
< 60 years	162 (39.9)	14 (8.6)	148 (91.4)		1
Ethnicity					
Malay	336 (82.8)	76 (22.6)	260 (77.4)	0.200	1.57 (0.78, 3.13)
Non-Malay	70 (17.2)	11 (15.7)	59 (84.3)		1
Marital status					
Married	381 (93.8)	78 (20.5)	303 (79.5)	0.067	0.46 (0.20, 1.08)
Single/widow/divorced	25 (6.2)	9 (36.0)	16 (64.0)		1
Living arrangement					
Stay alone	15 (3.7)	5 (33.3)	10 (66.7)	0.252 [c]	1.88 (0.63, 5.67)
Stay with family/friend	391 (96.3)	82 (20.5)	309 (79.5)		1
Education					
Primary	23 (4.7)	14 (60.9)	9 (39.1)	< 0.001 [d]	6.61 (2.75, 15.85)
Secondary	251 (62.8)	65 (25.9)	186 (74.1)		2.11 (1.24, 3.60)
Tertiary	132 (32.5)	8 (6.1)	124 (93.9)		1
Occupation					
Unemployed	205 (50.5)	68 (33.2)	137 (66.8)	< 0.001	4.76 (2.73, 8.28)
Employed	201 (49.5)	19 (9.5)	182 (90.5)		1
Household income					
Lower	144 (35.5)	57 (39.6)	87 (60.4)	< 0.001	5.07 (3.05, 8.41)
Middle	197 (48.5)	28 (14.2)	169 (85.6)		0.42 (0.26, 0.70)
Higher	65 (16.0)	2 (3.1)	63 (96.9)		1
Self-perceived financial					
Difficult	54 (13.3)	14 (25.9)	40 (74.1)	0.003	1.34 (0.69, 2.59)
Average	185 (45.8)	51 (27.6)	134 (72.4)		1.96 (1.21, 3.16)
Comfortable	167 (40.9)	22 (13.2)	145 (86.8)		1
Social engagement					
Less active	103 (25.4)	42 (40.8)	84 (59.2)	< 0.001	3.95 (2.38, 6.54)
Weekly engagement	303 (74.6)	45 (14.9)	258 (85.1)		1
Military rank category					
Non-officer	261 (64.3)	75 (28.7)	186 (71.3)	< 0.001	4.47 (2.34, 8.55)
Officer	145 (35.7))	12 (8.3)	133 (91.7)		1
Operational deployment					
Yes	278 (68.5)	64 (23.0)	214 (77.0)	0.249	1.37 (0.80, 2.32)
No	128 (31.5)	23 (18.0)	105 (82.0)		1
Pension payment					
Yes	342 (84.2)	76 (22.2)	266 (77.8)	0.368	1.38 (0.69, 2.77)
No	64 (15.8)	11 (17.2)	53 (82.8)		1

[a] Simple logistic regression

[b] Independent t-test

[c] Continuity Correction

[d] Likelihood Ratio

Malaysia, from 1 February 2021 until 30 November 2021. The target population included military veterans residing in KL. The sampling frame was based on the official data of active members of the KL branch of the veteran association that included 1,458 active members. Non-active members, on the other hand, were not included in the sampling frame. Then, simple random sampling was used to select the participants from the list.

Kish's equation was used to calculate the sample size, i.e. $n = Z^2 \times P(1\text{-}P) \div D^2$ whereby Z is the confidence level, p is the prevalence of MCI among males in Malaysia, and D is the margin of error. Using $Z = 1.96$, $p = 0.645$ (based on a previous study conducted in Malaysia)[3], and $e = 0.05$, the minimum sample size required was 352. In total, a total of 422 respondents were required after adding 20% of the non-response rate.

The inclusion criteria were veterans aged 40 years and above with at least ten years of military service. They must be literate and able to comprehend the national language, with no hearing and visual impairment. In contrast, those diagnosed with dementia, severe and debilitating stroke, or impaired motor function that could impede them from completing the psychometric assessment were excluded from the study. All potential respondents were contacted by phone calls and messages to invite them to participate in this study. A total of 406 out of the 422 veterans contacted met the study requirements and agreed to participate, giving rise to a 96.2% response rate. Veterans who agreed to participate signed a consent form prior to the questionnaire session. After receiving their informed consent, a face-to-face interview with the respondents was scheduled. The interview was conducted by trained research assistants and lasted about 30 minutes. The study has been approved by the Research Ethics Committee of the National University of Malaysia (FF-2020-537) and the Malaysian Armed Forces Health Service Division.

Measures

MCI was the dependent variable in this study. The respondents were

Table 2 Descriptive and bivariate analysis of the health-related characteristics with mild cognitive impairment (MCI)

Characteristic	Total, N (%)	MCI, N (%)	No MCI, N (%)	P-value χ^2	Crude OR [a] (95% CI)
Smoking					
Current smoker	91 (22.4)	22 (24.2)	69 (75.8)	< 0.001	1.23 (0.71, 2.13)
Ex-smoker	202 (49.8)	58 (28.7)	144 (71.3)		2.43 (1.48, 4.00)
Never smoke	113 (27.8)	7 (6.2)	106 (93.8)		1.00
Alcohol consumption					
Yes	43 (10.6)	7 (16.3)	36 (83.7)	0.399	0.69 (0.30, 1.60)
Stopped consumed	80 (19.7)	21 (26.3)	59 (73.8)		1.40 (0.80, 2.47)
Never consume	283 (69.7)	59 (20.8)	224 (79.2)		1.00
Physical activity					
Low	168 (41.4)	73 (46.8)	95 (56.5)	< 0.001 [c]	14.83 (7.94, 27.68)
Moderate	215 (53.0)	12 (5.3)	203 (94.4)		0.77 (0.04, 0.15)
High	23 (5.7)	2 (8.7)	21 (91.3)		1.00
Hypertension					
Yes	253 (62.3)	67 (26.5)	186 (73.5)	0.001	2.49 (1.44, 4.30)
No	153 (37.7)	20 (13.1)	133 (86.9)		1.00
Diabetes mellitus					
Yes	164 (40.4)	42 (25.6)	122 (74.4)	0.091	1.51 (0.94, 2.43)
No	242 (59.6)	45 (18.6)	197 (81.4)		1
Coronary artery disease					
Yes	53 (13.1)	17 (32.1)	36 (67.9)	0.043	1.91 (1.01, 3.60)
No	353 (86.9)	70 (19.8)	283 (80.2)		1
Stroke					
Yes	11 (2.7)	8 (72.7)	3 (27.3)	< 0.001 [b]	10.67 (2.77, 41.13)
No	395 (97.3)	79 (20.0)	316 (80.0)		1
Dyslipidaemia					
Yes	265 (65.3)	63 (23.8)	202 (76.2)	0.114	1.52 (0.90, 2.56)
No	141 (34.7)	24 (17.0)	119 (83.0)		
Hyperuricemia					
Yes	111 (27.3)	16 (14.4)	95 (85.6)	0.037	0.53 (0.29, 0.96)
No	298 (72.7)	71 (24.1)	224 (75.9)		1.00
Depression					
Yes	25 (6.2)	10 (40.0)	15 (60.0)	0.019	2.63 (1.14, 6.09)
No	381 (93.8)	77 (20.2)	304 (79.8)		1.00
Happiness					
No	137 (33.7)	43 (31.4)	94 (68.6)	< 0.001	2.34 (1.14, 3.80)
Yes	269 (66.3)	44 (16.4)	225 (83.6)		1.00
Subjective memory difficulty					
Yes	179 (41.9)	69 (38.5)	110 (61.5)	< 0.001	7.28 (4.13, 12.85)
No	227 (58.1)	18 (7.9)	209 (92.1)		1.00
Subjective concentration difficulty					
Yes	71 (18.0)	39 (54.9)	32 (45.1)	< 0.001	7.29 (4.17, 12.74)
No	335 (82.0)	48 (14.3)	287 (85.7)		1.00

[a] Simple logistic regression

[b] Continuity Correction

[c] Likelihood Ratio

screened for MCI using the Bahasa Malaysia version of the Montreal Cognitive Assessment (MoCA-BM) that had been validated within the Malaysian cultural milieu[10]. MoCA has greater sensitivity and specificity for MCI than the mini-mental state (MMSE) test[10]. A score below 23 was categorized as MCI[14]. The score for participants with less than 12 years of education was corrected by adding one point to their final score[10].

The independent variables in this study consisted of structured questions on sociodemographic information such as age, ethnicity, marital status, education level, living arrangement, social engagement, employment status, household income, and self-rated financial situation. The household income referred to the average family income per month[11]. It was further categorized into lower-income group (less than RM4,849), middle-income group (between RM 4,850 and RM 10,959) and high-income group (more than RM 10,960).

Meanwhile, social engagement and happiness status were measured in accordance with Shah *et al*.[12]. The social engagement was quantified through the frequency of participation in group activities (e.g., religious, volunteer, sports or clubs, hobbies, community meetings, or political meetings) at least once weekly. The happiness was measured using a scale of 0 (very unhappy) to 10 (very happy) in which any values of 7 and above would be categorized as happy. In addition, information was gathered regarding the history of military services, such as military rank, pension payment, and operational deployment.

Other independent variables include self-reported medical conditions (hypercholesterolemia, diabetes, hypertension, stroke, coronary artery disease, and hyperuricemia/ gout), subjective memory difficulty, subjective concentration difficulty, and lifestyle behaviors (alcohol consumption, smoking status, and physical activity). The Malay version of the International Physical Activity Questionnaire (IPAQ-M) was used to

Table 3: Multiple logistic regression analysis to predict the risk for MCI

Variables	β (SE)	Wald	Adjusted OR (95% CI)	P-value
Age group				
≥ 60 years	1.52 (0.40)	14.90	4.57 (2.22, 9.90)	< 0.001
< 60 years			1.00	
Military rank				
Non-officer	1.52 (0.49)	9.73	4.59 (1.76, 11.96)	0.002
Officer			1.00	
Education status				
Primary/secondary	1.10 (0.55)	4.09	2.98 (1.03, 8.78)	0.043
Tertiary			1.0	
Physical activity				
Low	2.33 (0.38)	37.31	10.29 (4.87, 21.727)	< 0.001
Moderate/active			1.00	
Hypertension				
Yes	0.80 (0.38)	4.43	2.22 (1.06, 4.67)	0.035
No			1.00	
Hyperuricemia				
Yes	-0.92 (0.41)	5.17	0.40 (0.18, 0.88)	0.023
No			1.00	
Memory complaint				
Yes	1.29 (0.38)	11.46	3.61 ((1.71, 7.60)	0.001
No			1.00	
Concentration complaint				
Yes	1.10 (0.40)	11.75	3.95 (1.80, 8.65)	0.001
No			1.00	

Model adjusted for occupation status, household income, self-perceived financial status, social engagement, smoking status, happiness status and heart disease.

quantify physical activity[13]. Meanwhile, depression was screened using the Bahasa Malaysia version of the Patient Health Questionnaire-9 (PHQ-9). A score of 10 and above were categorized as depression[14].

Statistical analysis

To determine the normality of the continuous data, Kolmogorov-Smirnov (K-S) test was performed. Age was normally distributed and described mean and standard deviation (SD). The independent student t-test, chi-square test, and simple logistic regression were used for bivariate analysis. In addition, the backward likelihood ratio (LR) method of logistic regression was utilized in the multivariable analysis to determine the risk factors of MCI. All key assumptions of multiple logistic regression were validated. A 'linear in logit' for independent numerical variable, i.e. age, was checked using the interaction between each variable and the log of itself. The assumption of 'linear in logit' for age was not satisfied. Thus, age was expressed as a categorical variable in the logistic regression. There was no interaction between the significant independent variables. The multicollinearity between the variables was assessed and the variance inflation factor (VIF) values were less than 5. No outlier was detected as Cook's influential statistics analog cut-off was less than one. All data were analyzed using Statistical Product and Service Solution (SPSS) version 24. The level of significance was set at the level of 0.05 (2-tailed test) and p-value < 0.05.

RESULTS

Characteristic of respondents

A total of 406 male veterans were included. Table 1 shows the characteristic of the participants. The mean age was 61.5 (standard deviation (SD) 8.4) years. About two-thirds (64.3%) of them had served in the military as non-officers. Most respondents were Malay (82.8%), followed by Indian (9.6%) and Chinese (7.6%). The majority of them were married (93.8%), staying with their family/ friend (96.3%), had secondary education (62.8%), unemployed (50.5%), and were categorized as middle-income earners (48.5%). The prevalence of MCI was 21.4% (n = 87). Significant differences were found between age group, education level, occupation, household income, self-perceived financial status, social engagement, happiness status, and military rank with MCI status.

Association between health-related characteristics and MCI

Table 2 compares the health-related profile of study participants with and without MCI. Significant differences were found between ex-smokers and MCI with a crude odds ratio (OR) of 2.43. Respondents who performed moderate physical activity appeared to be protected from MCI (OR 0.77), as compared to respondents with low physical activity who was 14.83 times more likely to develop MCI. Similarly, hypertension (OR 2.49), heart disease (OR 1.91), stroke (OR 10.67), depression (OR 2.63), unhappiness (OR 2.34), subjective memory difficulties (OR 7.28), and concentration difficulties (OR 7.29) were all linked with a higher likelihood of getting MCI. In contrast, higher uric acid showed a protective effect from MCI (OR 0.53).

Predictors of MCI

Finally, in the multivariable analysis, eight factors, namely age group, military rank, primary education, subjective memory difficulty, subjective concentration difficulty, low physical activity, hypertension, and hyperuricemia, were significant predictors of MCI (Table 3). The model correctly classified 87.7% of the respondents. Neither interaction nor collinearity was present. The Nagelkerke's R^2 was 0.683. Meanwhile, the Hosmer-Lemeshow goodness-of-fit test was not significant (p = 0.910). Therefore, the dataset fit well with the logistic model. Two significant variables in the bivariate analysis (stroke and depression) were not included in the logistic regression model as the proportion of the diseases was too small (less than 10%). Meanwhile, the primary education group (4.7%) was combined with the secondary education group. Similarly, the high physical activity group (5.7%) was combined with the group with moderate exercise.

DISCUSSION

This study was the first to explore the prevalence and the factors associated with MCI among male veterans in Malaysia. The prevalence of MCI was lower than previous studies conducted among older male adults in Malaysia (64.5%-64.9%)[3,4]. In comparison, this study was conducted in the veteran community with a lower mean age compared to Razali et al. and Samy et al. which were conducted in hospital and primary care settings respectively[3,4]. Nevertheless, when comparing the proportion of older veterans with MCI, the prevalence was still low (30.3%) in our study even though Samy et al. applied a similar cognitive assessment tool (MoCA-BM)[4]. A published cohort study with a median of 11.5 years of follow-up revealed that military veterans recorded a significantly less decrease in cognitive scores compared with their civilian counterparts[15]. This can be explained by a "healthy warrior effect", whereby veterans might be healthier in some ways as compared to the general population for them to serve in the military. For instance, they need to fulfill certain requirements for physical fitness and operational readiness as part of the standards for selection and acceptance into the military. In addition, the guaranteed health care and assistance after retirement may also indirectly cast a protective effect on their cognition and mental stability.

Based on the findings, most of the factors associated with MCI in this study are preventable, including low physical activity, hypertension, and lower education level. If these modifiable risk factors can be prevented or controlled, the overall risk of MCI will be reduced. Apart from that, subjective memory, concentration difficulties, and being a non-officer could also increase the risk of MCI. Thus they should be used as a screening mechanism for the prevention strategies.

In contrast, exercise has a protective effect against cognitive impairment as reported in a study conducted among Chinese veterans[2]. Undeniably, regular physical activity has been proven to have an extraordinary capacity in reducing cognitive decay. Growing evidence supports the positive influence of exercise in maintaining the vitality of the central nervous system (CNS) and promotes resistance against neurological disorders[16,17]. However, it remains unclear what is the ideal frequency and intensity of the exercise for the veterans. Studies have established a dose-response relationship between physical activity and cogni-

tive function. The more often, higher intensity, and the earlier one starts to exercise, the lower the risk of developing cognitive decline[18]. For veterans with joint problems or those who are unable to perform vigorous exercise, they can resort to walking activities. Even regular walking with low intensity has been shown to increase the size of the hippocampus and thus reducing the risk of cognitive disorders[19]. For those who are unable to move around or face obstacles in getting out of the house due to the COVID-19 pandemic, they can perform resistance training that can also help to reduce the risk of cognitive disorders[20].

In addition, regular physical activity is also essential in preventing and controlling hypertension[21]. High blood pressure is one of the leading causes of cognitive impairment[22]. Currently, there is no specific policy for military veterans in Malaysia to undergo regular health check-ups after retirement. Therefore, they should be made aware of the importance of regular health screening. More importantly, a health screening policy should be implemented by the Veteran Affairs Department to ensure veterans undergo regular physical and mental health check-ups. Regular health check-ups provide the best opportunity to identify and tackle the risk factors of cognitive disorders, apart from providing relevant health education. In addition, veterans with hypertension should also be optimally treated as evidence has shown that antihypertensive treatment can potentially reduce the risk of cognitive decline[23].

With regard to the military rank, those from the non-officer group recorded a higher risk of mild cognitive impairment. Military rank is a proxy of social hierarchy whereby a higher rank is related to a better health outcome[24]. Generally, the non-officers often have a lower educational background than officers. It may also reflect their lower ability to deal with stress and solve problems. Scientific evidence indicated that the duration and level of education are significantly associated with cognitive performance[2]. Therefore, the Ministry of Defense should strive to increase the academic qualifications required for entry into the service. More importantly, military personnel, especially those in the non-officer group, should be given the support and opportunities to pursue further study at the tertiary level during their service. The need for higher education is also important to give veterans the opportunity to get more secure employment after retirement. Although the regression model in this study does not show the significant association between employment status with the risk of MCI, but there is study revealed unemployed with the risk of cognitive impairment.[25] People frequently join the military after graduating from high school. As a result, they may lack the education required for many jobs.

Many veterans have difficulty finding work after they retire[26]. They face a difficult career transition due to the disparity in employment environments between military service and civilian life. Simultaneously, military retirees may possess skills that are incompatible with the requirements of the civilian labour market, making it difficult for them to find work[26]. This, combined with intense competition from individuals younger than them, results in a scarcity of employment opportunities. Indeed, the current COVID-19 pandemic is limiting employment opportunities[27]. As a result, the Veteran Affairs Department should also assist veterans in obtaining guaranteed employment.

Next, subjective cognitive complaints such as memory and concentration difficulties were also significantly associated with MCI. However, a study has shown that subjective cognitive complaint was associated with mood conditions such as anxiety and depression, rather than cognitive impairment[28]. In contrast, a longitudinal study found that subjective memory complaint was associated with cognitive impairment[29]. Meanwhile, a meta-analysis revealed that 26.6% of people with subjective memory complaints developed MCI, and another 14.1% subsequently developed dementia. In addition, there was a two-fold increase in the risk of dementia among people with subjective memory complaints[30]. Therefore, veterans who report any subjective memory or concentration problems should undergo a cognitive assessment to ascertain their cognitive function.

Finally, this study supported the previous findings that hyperuricemia is a protective factor for MCI[31]. One possible postulation was the antioxidant properties found in uric acid can exert a neuroprotective effect. However, the relationship between serum uric acid levels and cognitive function remains debatable. Some studies found that the risk reduction is more pronounced for patients treated with anti-hyperuricemia drugs[32] as compared to other study that reported conflicting results[33].

This study has several limitations. Firstly, the status of chronic disease was based on self-reporting data without medical evidence. Secondly, other factors related to cognitive function such as diet and anxiety were not captured in the study. Additionally, this study was conducted during the COVD-19 pandemic and there might have been unexplored effects of the COVID-19 pandemic on the participants' mental health. Thirdly, the list of veterans in the sampling frame was not representative of all the male veterans in Malaysia. In addition, because this study excluded female veterans, its findings are biased toward male veterans and cannot be generalized to all veterans.

CONCLUSION

This study determined the prevalence and factors related to MCI among male veterans in Malaysia. Several identified risk factors, such as low physical activity, hypertension, and lower education level, are deemed preventable. Therefore, public health action in terms of control and prevention programs must be emphasized during working years. Furthermore, health education focusing on the promotion of healthy behaviors combined with routine medical examinations must be performed regularly after retirement. To ensure the success of such a program, full participation from the veterans is vital. Finally, future research should consider a cohort study to determine the temporal link between MCI and the risk factors.

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CONFLICT OF INTEREST

The author declares that there is no conflict of interest. The views expressed are solely those of the authors and do not reflect the official policy or position of the National University of Malaysia, Malaysian Armed Forces, or Malaysian Government.

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