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Original article

Personality change and associated factors in patients with mild cognitive impairment

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Background: Previous studies have shown that a history of personality change might guide the diagnosis of early mild cognitive impairment (MCI), which would lead to earlier treatment and better outcome of dementia.
Objectives: To investigate personality change and other factors associated with MCI.
Methods: This cross-sectional descriptive study was conducted by recruiting information from 83 patients with MCI at King Chulalongkorn Memorial Hospital using Thai version of questionnaires about demographic data, the Thai Mental State Examination (TMSE), the Montreal Cognitive Assessment (MoCA), the Thai Geriatric Depression Scale, the Neuropsychiatric Inventory Questionnaire (NPI-Q) and the International Personality Item Pool (IPIP). The patients' caregivers were also asked to evaluate the patients' personality during the 5 years prior to the diagnosis and their current personality. The statistical analyses were frequency, percentage, mean and *t* - test. Analysis of factors correlated with personality change was performed with logistic regression.
Results: Eighty-three patients were included, showing a mean age of 72.1 ± 7.1 years old with 61.4% of them being female. The mean TMSE was 27.6 ± 1.9 and the mean MoCA was 21.6 ± 3.1. Personality change in patients with MCI showed a statistically significant increase in neuroticism and a decrease in openness to experience, agreeableness and conscientiousness ($P < 0.05$). There was a negative correlation between emotional stability, agreeableness, and NPI-Q (r = - 0.442 and - 0.227) ($P < 0.001$ and $P = 0.039$). A positive correlation between extraversion and MoCA was found ($r = 0.336$) ($P = 0.002$). Neuroticism was detected to have a correlation with neuropsychiatric symptoms (NPS), including irritability, anxiety, depression, apathy, disinhibition, and agitation. There was a significant correlation between agreeableness and NPS (apathy) ($P < 0.05$).
Conclusions: Our findings suggest that there was personality change in MCI patients, featuring an increase in neuroticism, openness to experience, and agreeableness and a decrease in extraversion and conscientiousness. Extraversion was found to be positively correlated with cognitive functions and there was a positive and negative correlation with NPS among neuroticism and agreeableness, respectively.

Keywords: Personality, personality change, neuropsychiatric symptom, mild cognitive impairment, mild neurocognitive disorder.

Mild cognitive impairment (MCI) is a condition in which patients have a deficit of at least one cognitive domain, but it is not severe enough to be diagnosed as dementia. [1, 2] The prevalence of MCI becomes increasingly common as individuals grow old. [3] It was estimated that 80 % of patients with MCI would later develop dementia within 6 years. [4] Therefore, early diagnosis and treatment of MCI could be an important strategy for preventing dementia.

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Personality can be defined as a set of characteristics that an individual shows or reacts to the surroundings, including thought, behavior, and emotion. It is a personalized summation of each person's development through prior periods of life. [5] The five-factor model of personality is one of the standard tools for indicating personality traits, which comprises of neuroticism, extraversion, openness to experience, agreeableness and conscientiousness. [6]

A few prior studies have stated that there was a significant change of personalities in dementia patients compared to those of the normal aging population which was rather constant. The changes of personality were an increase in neuroticism, a decrease in extraversion, openness to experience, agreeableness and conscientiousness. [7 - 9] A study by Balsis S. has revealed that the change in personality of Alzheimer

patients could be depicted in the early stage of the disease or even prior to the diagnosis.[10] Furthermore, a recent study has revealed that once the changes in personality were detected, the person would develop dementia within 2 years.[11] A study by Donati A, *et al.* stated that personality change was found in an MCI group, consisting of a decrease in extraversion, and conscientiousness and an increase in neuroticism, while openness to experience and agreeableness seemed to be stable compared to the normal aging group.[12] The results of the aforementioned research corresponded with the results of a study by Mendez Rubio M, *et al*.[13] However, some studies have shown different results. Yoneda T, *et al*. found only a rise in neuroticism in patients with MCI.[14] A study by Caselli RJ, *et al*. perceived an increase in neuroticism and a decrease in openness to experience.[15] Nonetheless, opposite results were also noticed, for example, Terracciano A, *et al*. did not observe significant personality change in patients with MCI and dementia.[16]

There were some factors associated with personality change in MCI, for example, dysnomia[17], neuropsychiatric symptoms (NPS), associated with faster progression of dementia[18], an increase in disability and poor quality of life, earlier hospital admission, and an increase burden for caretakers.[19] Personality change is also believed to be useful information in making a diagnosis of MCI, which then leads to earlier treatment and better outcome for the patients. However, there are still limited numbers of studies on this issue and some also show conflicting results.[12]

The aim of this research was to identify the characteristics of personality change and factors associated with MCI. Therefore, earlier diagnosis and treatment of MCI could be an important strategy for preventing dementia.

Materials and methods

Participants

Eighty-three participants and their caregivers were recruited within the Outpatient Clinic of the Department of Psychiatry, King Chulalongkorn Memorial Hospital, Bangkok, Thailand from November 2017 to April 2018. The study was carried out in accordance with the Declaration of Helsinki and approved by the Ethics Committee, the Institutional Review Board (IRB) of the Faculty of Medicine, Chulalongkorn University (COA No. 748/2017). After giving a complete description of the study to the participants and their caregivers, written informed consents were obtained voluntarily. The sample size was calculated resulting in a sample size of 83.

The inclusion criteria were an age of 50 years old or more, being diagnosed with MCI using the International Working Group criteria for general MCI[20] by reviewing medical records and the Thai Mental State Examination with scores of more than 23, and the Montreal Cognitive Assessment-Thai version with scores less than 25, normal activities of daily living (ADL), understanding Thai language with the ability to communicate by listening, speaking, reading, and writing, and the caregiver of participants had been near the patients since the age of 40[21] and was able to assess the patients' personality before entering the study. The exclusion criteria were being diagnosed with dementia, having active psychiatric problems by history and reviewing medical records.

Measurements

The clinical assessments were done by history taking about cognitive impairment, duration of MCI, underlying psychiatric disorders and medical illnesses, and medications used with a questionnaire consisting of demographic data (gender, age, marital status, occupation, highest education level, hometown, current address).[2, 12] The physical examination and mental status examination were assessed. Caregivers were evaluated by interviewing and questionnaire.

The cognitive assessment comprised of TMSE and MoCA. The TMSE, developed by the Train the Brain Forum Committee (Thailand), had six categories of questions including orientation, registration, attention, calculation, language, and recall. The results were evaluated by the researcher. MCI was diagnosed when the score was less than 23 out of 30.[22] The MoCA, comprised 30 questions and was used to evaluate cognitive functions in several aspects as follows: executive function, visuospatial ability, naming, memory, attention, language, abstraction, delay recall, and orientation. The cut point score of the MoCA was 24 points. There were sensitivity of 0.8, specificity of 0.8 for amnestic MCI and sensitivity of 1.0, specificity of 0.98 for Alzheimer's disease and excellent internal consistency (Cronbach's alpha 0.914). The MoCA score was evaluated by the researcher. The total score was 30 points. A score of fewer than 25 points indicated MCI. One point was added for those who had 6 or less than 6 years of education.[23]

Personality traits were assessed by the International Personality Item Pool (IPIP)-Thai version, and consisted of 60 questions. It was interpreted into five factors of personality traits which were emotional stability (the opposite character of neuroticism), extraversion, openness to experience, agreeableness, and conscientiousness. The personality facet or subtraits of a personality trait is a specific aspect of a broader personality trait.[24] The personality facets of the Thai version of the IPIP are demonstrated in Table 1. The Thai version of the IPIP contains some personality facets from five-factor personality theory. Internal consistency reliability was measured by Cronbach's alpha ranging from 0.69 to 0.90 and test-retest correlation ranging from 0.66 to 0.89.[25] The IPIP was done by caregivers evaluating the patient's personality in the present and personality in the 5 years prior to the diagnosis of MCI.

The NPI-Q Thai version consisted of questions about twelve aspects of NPS in MCI patients, including delusions, hallucinations, agitation or aggression, depression, anxiety, euphoria, apathy, disinhibition, irritability, motor disturbance, nighttime behaviors, and changes in appetite. The test was done by caregivers by answering whether the patients had the symptoms in the previous four weeks or not. If symptoms were present, the severity of 1 - 3 points (less severe to very severe) would be further accessed. The total score was the sum of the twelve aspects, ranging between 0 - 36 points. The caregivers' distress was also evaluated in each aspect that the symptoms present, ranging from 1- 5 points (absent suffering to severe suffering). The sum score would be between 0 - 60. The NPI-Q was developed by Kaufer DI, *et al*.[26] which was adapted from the NPI (Neuropsychiatric Inventory).[27]

Statistical analysis

The personality change in all patients was calculated by the mean of difference between IPIP scores at present and IPIP scores from previous 5 years prior to MCI. Descriptive statistics were used to show demographic data of the samples, including frequency, percentage, and mean and standard deviation (SD). Inference statistics were used to find correlations among factors related to personality change, including unpaired *t* - test and Pearson's correlation for interval and ratio variables and Chi square for numerical data.

Results

Participant characteristics

Demographic data are presented in Table 2. Most of the recruited samples were female (61.4%) and unemployed (81.9%). The mean age was 72.1 ± 7.1 years old. Most had some underlying diseases, with equal numbers of hypertension and dyslipidemia (each was 55.0%). There were 85.5% who used medication (excluding cognitive enhancers), when 30.1% used cognitive enhancers. Thirty-eight point six percent were taking psychiatric medication. Some psychiatric conditions were diagnosed in 21.7% of the samples, 10.8% with depression and 8.4% with anxiety disorder. MCI was diagnosed in 66.3% with a mean interval time for diagnosis of 4.2 ± 4.6 years.

Table 1. Personality facets of personality traits in Thai version of IPIP.

Personality traits	Personality facets
Emotional stability	Anger/stability, anxiety
Extraversion	Extraversion, social adjustment
Openness	Imaginative, sophistication, fluency
Agreeableness	Agreeableness
Conscientiousness	Self-discipline/perfectionism, orderliness, responsibility

Table 2. Demographic and clinical data of patients with mild cognitive impairment.

Characteristic	n (%) or mean ± SD
Age (years)	72.1 ± 7.1
Gender (female)	51 (61.4)
Current occupation	
No career/Retirement	68 (81.9)
Private business/Trading	12 (14.5)
Employee	2 (2.4)
Government official	1 (1.2)
Income (yes)	59 (71.1)
Education level (years)	13.7 ± 5.5
Duration of MCI (years)	4.2 ± 4.6
Medical underlying diseases	80 (96.4)
Hypertension	44 (55.0)
Dyslipidemia	44 (55.0)
Musculoskeletal system	22 (27.5)
Diabetes mellitus	17 (34.0)
Cardiovascular system	13 (16.3)
Neurological disease	12 (15.0)
Obstructive sleep apnea	9 (11.3)
Urinary system	7 (8.8)
Thyroid disease	5 (6.3)
Gastrointestinal system	4 (5.0)
Respiratory system	4 (5.0)
History of psychiatric disorders	18 (21.7)
Depressive disorder	9 (10.8)
Anxiety disorder	7 (8.4)
Insomnia disorder	1 (1.2)
Bipolar disorder	1 (1.2)
Drugs for medical disease	71(85.0)
Cognitive enhancing drugs	25 (30.1)
Psychotropic drugs	32 (38.6)
TMSE	27.6 ± 1.9
MoCA	21.6 ± 3.1
NPI-Q	56 (67.5)

MCI: mild cognitive impairment; TMSE: Thai Mental State Examination
MoCA: Montreal Cognitive Assessment; NPI-Q: Neuropsychiatric Inventory Questionnaire

According to Table 3, there was statistically significant differences in the personality change of MCI patients featuring emotional stability, openness, agreeableness and conscientiousness with a difference of 0.5 ± 1.6, 0.6 ± 1.2, 0.3 ± 1.0, and 0.5 ± 1.0, respectively.

The correlations between personality change and other factors are demonstrated in Table 4. There is a positive correlation between a change in extraversion scores and MoCA scores (r = 0.336). The changes in emotionally stable and agreeableness scores were negatively correlated with NPI-Q scores (r = - 0.442 and - 0.227, respectively). However, education levels and duration of MCI were not significantly correlated with personality changes.

Table 5 shows an association between personality change and NPS. Emotional stability was significantly associated with NPS (irritability, anxiety, depression, apathy, disinhibition, and agitation). There was a statistically significant association between agreeableness and apathy.

Table 3. Personality change in patients with mild cognitive impairment.

Personality Change	Prior to diagnosed MCI	Present	Difference	*P* - value
Emotional stability	5.9 ± 2.4	5.4 ± 2.4	0.5 ± 1.6	0.008*
Extraversion	6.1 ± 1.6	5.8 ± 1.6	0.2 ± 1.4	0.132
Openness	5.3 ± 2.1	4.7 ± 2.0	0.6 ± 1.2	< 0.001**
Agreeableness	7.1 ± 1.8	6.8 ± 1.8	0.3 ± 1.0	0.012*
Conscientiousness	6.8 ± 1.8	6.3 ± 1.8	0.5 ± 1.0	< 0.001**

The data were analyzed with paired *t* - test and presented by mean ± SD
* $P < 0.05$, ** $P < 0.001$

Table 4. Correlations between personality change and other factors.

Personality change	Education	Duration of MCI	MoCA	NPI-Q
Emotional stability	0.126 (0.330)	0.017 (0.880)	0.015 (0.893)	- 0.442 (< 0.001)**
Extraversion	- 0.041 (0.750)	0.085 (0.446)	0.336 (0.002)*	- 0.186 (0.092)
Openness	- 0.028 (0.828)	- 0.043 (0.702)	0.144 (0.193)	- 0.156 (0.159)
Agreeableness	0.083 (0.523)	0.052 (0.639)	0.050 (0.653)	- 0.227 (0.039)*
Conscientiousness	- 0.043 (0.740)	0.071 (0.522)	- 0.061 (0.585)	- 0.113 (0.307)

MoCA: Montreal Cognitive Assessment; NPI-Q: Neuropsychiatric Inventory Questionnaire
The data were presented by Pearson's correlation coefficient (*P* - value)
* $P < 0.05$, ** $P < 0.001$

Table 5. Association between personality changes and neuropsychiatric domains.

Neuropsychiatric domains	Emotional stability		Agreeableness	
	χ^2	*P* - value	χ^2	*P* - value
Irritability	14.024	< 0.001*	2.615	0.106
Anxiety	8.136	0.004*	1.576	0.209
Depression	8.694	0.003*	0.085	0.770
Apathy	7.136	0.008*	7.202	0.007*
Disinhibition	10.068	0.002*	1.436	0.231
Agitation or aggression	6.545	0.011*	2.036	0.154
Total NPS	3.363	0.067	3.391	0.066

The data were analyzed with logistic regression analysis and presented by Wald χ^2
* Statistically significant at the 0.05 level

Discussion

According to the results, personality change in MCI patients was found. Neuroticism increased whereas openness to experiences, agreeableness, and conscientiousness decreased; in line with previous studies.[8, 12 - 15] Nonetheless, the details were dissimilar, that is, all previous studies disclosed higher neuroticism in MCI patients. Lower personality changes in other aspects were different. For example, the study Yoneda T, *et al*. [14] revealed only higher neuroticism. The study of by Caselli RJ, *et al*.[15] showed higher neuroticism and lower openness to experiences. The dissonant findings might have arisen from different methodologies because Yoneda T, *et al*. [14] and Caselli RJ, *et al.* [15] followed up the patients since before diagnoses until they were diagnosed with MCI. This possibly led to the discovery of initial changes. Comparing with the samples in this study, most of them had been diagnosed with MCI for a period of time, possibly resulting in subsequent personality change as well as different study results. This is the first study of MCI patients whose agreeableness was found to be lower. It might be caused by the differences in illness durations in patients who were diagnosed with

MCI. That is because the studies in dementia patients found that lower agreeableness related to illness durations in the samples. [28] Even so, further studies are required in order to confirm such a hypothesis in MCI patients.

Some studies tried to describe the mechanisms engendering the aforementioned personality change. To illustrate, previous neurobiological and neuropathological studies, both in structural[29] and functional aspect,[30] figured out that there was a change in the structure and functions of the brain in different positions in MCI and dementia patients, particularly the frontotemporal regions, bringing about the personality and behavioral changes. It was believed that such functional change might have happened for years before MCI or dementia. In some certain cases, therefore, personality and behavioral changes were found before the occurrence of MCI.[31, 32] In addition, some other studies also tried to elaborate on the mechanism of specific personality change, both in structural and functional aspects.[33 - 36] For example, higher neuroticism related to higher dorsal anterior cingulate cortex functions,[35] and smaller cerebral grey matter, ventrolateral prefrontal cortex/ dorsolateral prefrontal cortex, and orbitofrontal cortex [33] whereas agreeableness related to lower prefrontal functions [35] and smaller right orbitofrontal cortex.[34] Still, when involved studies proved that the functional position of brain overlapped with one another despite investigated different personalities, it initiated a hypothesis assuming that personality change in each aspect might be caused by the balance of several neural circuits of the nervous system rather than by the functions of only one position of the brain or circuit.[37]

We also realized that extraversion had positive relations to MoCA, like the study of Yoneda T, *et al.*[14] in view of lower extraversion in MCI patients, compared with the healthy elderly. These findings might have resulted from extraversion or the likelihood of sociability and interpersonal interactions. Higher extraversion impinged on higher sociability and satisfactory cognition in MCI patients, following the knowledge from previous studies.[38, 39] Furthermore, emotional stability had positive relations to NPS, i.e., irritability, anxiety, depression, apathy, disinhibition, and agitation or aggression. This was similar to the study by Mendez Rubio M, *et al.*[13] who confronted the relations between neuroticism and apathy, irritability, anxiety, and depression. That was because those with higher neuroticism could handle stress poorly, leading to easier negative emotions. [40, 41] Besides, neuropathological studies exhibited higher neuroticism, lower prefrontal functions,[35] and smaller ventrolateral prefrontal cortex/dorsolateral prefrontal cortex as well as orbitofrontal cortex.[33] This introduced higher frontal lobe dysfunctions (disinhibition, agitation or aggression, irritability, and apathy). The researchers also found that agreeableness had negative relations to NPS, i.e., apathy. This confirmed the knowledge from the study by Archer N, *et al.*[42] in the sense that low agreeableness related to agitation and apathy because those with low agreeableness had a problem of self-adaptation to others owing to MCI. What came after included stress, irritability, and unsociability. These were all factors affecting worse psychiatric symptoms and cognition. Based on neuropathological studies with the findings of the relations between lower agreeableness and lower prefrontal functions[35], and smaller right orbitofrontal cortex [34], frontal lobe dysfunctions got higher.

There are some limitations of our study. Firstly, this study is a cross-sectional descriptive study, thus only the associations of personality change and factors related to personality change were accessed. Causal relationships might not be demonstrated. Secondly, this study was conducted at the Outpatients Clinic, the Department of Psychiatry, King Chulalongkorn Memorial Hospital, so generalization to other groups of a population might be limited. Thirdly, this study did not exclude the samples with underlying psychiatric disease, therefore indicating that the personality change was due to the underlying disease or MCI. Moreover, there might be recall bias in recollecting the patients' personality in the past by the caregivers since the duration prior to the diagnosis varied. Lastly, the variety in the caregivers' backgrounds might have an effect on the score they gave.

Future studies might be done as prospective analytic studies to demonstrate a causal relationship. Collecting data from more than one caregiver per patient to access the reliability of the information or selecting the samples who had been recently diagnosed with MCI to decrease recall bias. Further study about the mechanism of personality change in MCI could be done for a better pathophysiological understanding. Collecting more samples from other clinics or the community to increase the numbers of subjects may extend the results further for a bigger group of the population.

Conclusion

Our findings suggest that there was personality change in MCI patients, featuring an increase in neuroticism, openness to experience, and agreeableness and a decrease in extraversion and conscientiousness. Extraversion was found to be positively correlated with cognitive functions and there was a positive and negative correlation among neuroticism, agreeableness, and NPS, respectively.

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Conflict of interest

The authors, hereby, declare no conflict of interest.

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