

# Supporting Older Adults with Mild Cognitive Impairment in Medication Taking: A 2-year Longitudinal Study

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## Abstract

### Objective:

Community dwelling older adults with mild cognitive impairment (MCI) encounter challenges in many daily activities including medication taking. With inadequate health literacy, many of them have difficulty in understanding the instructions on drug labels and make decision on medication taking. This study aims to assess the effect of two interventions, verbal advice plus educational leaflet (VAEL) and comic books (CB), on medication taking among persons with MCI.

### Methods:

This is a two-year multi-site longitudinal study with pre-and-post design and four-point measures (Time 1, 2, 3, and 4). Subjects were aged 60 or above, scored <22 in Chinese version of the Montreal Cognitive Assessment (MoCA), and were taking  $\geq 2$  drugs regularly. Health literacy was measured by the 24-item Chinese Health Literacy for Chronic Care (CHLCC) and medication adherence was measured by the 8-item Morisky Medication Adherence Scale (MMAS). Generalized Linear Mixed Models (GLMM) and Generalized Estimating Equation (GEE) were used.

### Results:

Among the 131 subjects, the majority (62%) were females and mean age was 82.5 (SD 6.5). One-third of them received primary education (31%). Controlling age, there was a significant increase in CHLCC scores after the use of CBs (T4-T3: coefficient=2.742,  $p=0.003$ ; T4-T1: coefficient=5.073,  $p=0.014$ ). On the other hand, comparing to the baseline at T1 and controlling age, the chance of moving MMAS level one level higher than its original level at T4 was high (O.R.=3.316, S.E. 0.2979, 95% CI 0.650-1.747,  $p<0.001$ ). Similar improvement in MMAS level was observed at T3 and T2.

### Conclusion:

The two interventions (VAEL and CBs) seem to be a good strategy to improve health literacy and medication adherence among community dwellers with MCI. More research is warranted to support medication taking in this specific population.

### Keywords:

Medication, Mild cognitive impairment, Older adults, Longitudinal study, Medication adherence, Health literacy

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## Background

Community dwelling older adults with mild cognitive impairment (MCI) encounter different challenges in daily lives, including gradual decline in cognition, self-administering multiple medications, and inadequate health literacy. Health literacy is defined as “the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions” [1]. Consequences of inadequate health literacy include poor physical and mental health [2], higher hospitalization rate [3], less use of flu vaccination [4], and higher mortality [5].

Relationship between health literacy and medication adherence is well documented [6,7]. A recent meta-analysis confirmed that the relationship between health literacy and medication adherence was significant ( $r=0.056-0.088$ ,  $p < 0.001$ ) although it was weak [8]. Poor health literacy has been identified as a major cause of medication non-adherence [9]. For those who have inadequate health literacy, they are more likely to misunderstand medication instructions and have difficulties in following correct drug regimen [9].

It is not difficult to find examples of challenges from drug labels. When individuals read the drug labels, we can easily find instructions like: ‘take on an empty stomach’, ‘take 1 pill every 12 hours by mouth with a meal’, ‘do not chew or crush’, ‘swallow whole’, ‘take with food’, ‘avoid prolonged or excessive exposure to direct and/or artificial sunlight while taking this medication’ or ‘medication should be taken with plenty of water’. A significant percentage of older adults failed to understand these instructions [10,11]. For those who suffer from mild cognitive impairment (MCI), they may find these instructions less understandable. MCI is an intermediate stage between the expected cognitive decline of normal aging and the more-serious decline of dementia [12]. MCI can involve problems with memory, language, thinking and judgment that are greater than normal age-related change.

To support community-dwelling older adults in medication taking, a team of volunteers named as ‘Medication Use Supportive Team – MUST’ were trained to visit these older adults. Two interventions, verbal advice plus educational leaflets (VAEL) and health literacy-oriented comic books (CB), were developed in 2016 and 2017 respectively. Structured protocols were set up to guide the Medication Use Supportive

Team members to conduct the interventions. This study aims to investigate the effect of these interventions on medication taking (including medication adherence and health literacy) among older adults with mild cognitive impairment (MCI).

## Methods

This is a two-year multi-site longitudinal study with pre-and-post design and four-point measures (Time 1, 2, 3, and 4).

### ■ Measures

This study includes two outcome measures, medication adherence and health literacy. Medication adherence was measured by the 8-item Morisky’s Medication Adherence Scale (MMAS) – Chinese version [13,14]. The total MMAS score ranged from 0 to 8. There were 3 MMAS levels: MMAS level 1 referred to the MMAS score lower than 6, indicating ‘poor adherence’; MMAS level 2 referred to the MMAS score 6 to 7, indicating ‘medium adherence’, and MMAS level 3 referred to MMAS score 8, indicating high adherence. Health literacy was measured by the 24-item Chinese Health Literacy for Chronic Care (CHLCC) [15]. The total CHLCC score ranged from 0 to 48. Higher total score indicates higher health literacy level. In addition, we also assessed activity of daily living (ADL) and depressive symptoms. Activity of daily living was measured by Barthel Activity of Daily Living (ADL) scale. The higher the Barthel ADL score, the higher the capacity to carry out ADL activities independently [16]. Depressive symptoms were measured by Geriatric Depression Scale (GDS). GDS score higher than 8 indicates the likelihood of suffering from depressive symptoms.

### ■ Samples

Only those who were aged 60 or above, were taking  $\geq 2$  drugs regularly, and with mild cognitive impairment (MCI) were included in this study. MCI was defined as ‘scored  $< 22$  in Chinese version of the Montreal Cognitive Assessment (MoCA) [17]. For those with 6 years or less in education, 1 score was added [17].

### ■ Interventions

Two interventions are included in this study: Intervention 1 is a 90-minute intervention using verbal advice and a written educational leaflet (VAEL) while Intervention 2 is also a 90-minute intervention using health literacy-oriented comic

books (CBs). Each intervention was carried out in two home visits to each subject. Medical/nursing/pharmacy students were trained as volunteers to carry out these interventions according to the standard protocols. Both interventions aim to improve older adults' health literacy and medication adherence.

■ **Schedule of measurements**

A baseline assessment was made before the implementation of Intervention 1 using VAEL and this is considered as Time 1 (T1). A post-intervention assessment was made after VAEL at Time 2 (T2). One year later, another assessment was made at Time 3 (T3) before the implementation of Intervention 2 using CBs to educate the subjects. A post-intervention assessment was made at Time 4 (T4) after CBs.

■ **Data analysis**

We reported descriptive analysis of subjects' demographics, ADL level and level of depression. Continuous variables were presented as means and standard deviations while ordinal or categorical variables were presented in numbers and percentage. An overall p value less than 0.05 was used to determine statistical significance. Generalised linear mixed models (GLMM) were used to compare the mean health literacy scores at different time points. Coefficient estimates and p values were reported. General Estimating Equation (GEE) was used to compare MMAS level over time. Odds ratios, standard errors and p values were reported.

■ **Ethical approval and consent**

Both The University of Hong Kong/ The

Hospital Authority's Hong Kong Island West Cluster Institutional Review Board (UW 15-545) and The Hong Kong Polytechnic University's Human Subjects Ethics Subcommittee (HSEARS20160913002-01) approved this study. All participants enrolled in this study provided a written informed consent.

**Results**

A total of 131 subjects were included. The majority (82%) were females, and the mean age was 82.5 (SD 6.5) (Table 1). More than half (55%) received no formal education, 31% received primary education and 14% received secondary education or above. About one-third (31%) were living alone.

■ **Change of health literacy**

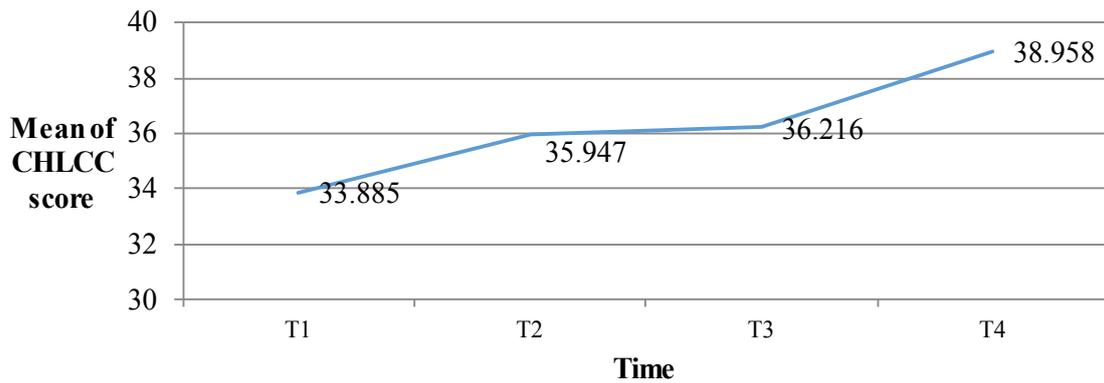
The mean of CHLCC score accelerated from 33.9 at T1, to 35.9 at T2, to 36.2 at T3, to 39.0 at T4 (Figure 1). Controlling age, the mean CHLCC score at T4 was significantly different from the one at T1 (coefficient=5.073, p=0.014) (Table 2). The mean CHLCC score at T4 was also significantly different from the one at T3 (coefficient=2.742, p=0.003) (Table 2).

■ **Change of medication adherence level**

Table 3 showed the distribution of MMAS scores and MMAS levels at different time. About 30 (23.4%) subjects were considered as poor medication adherence, and half (53.1%) were medium adherence (Table 3). In consideration of the possible ceiling effect of medication adherence, 30 subjects whose MMAS scored 8 were excluded from the GEE analysis. Comparing to the MMAS level at T1 and

**Table 1: Demographics.**

	n	%
<b>Age</b>	M: 82.5	SD: 6.50
<b>Sex</b>		
	Female	81 61.8%
<b>Education level</b>		
	No formal education	60 55.0%
	Primary	34 31.2%
	Secondary or above	15 13.7%
<b>Living status</b>		
	Living Alone	26 20.6%
	Living with Spouses	43 34.1%
	Living with Children	26 20.6%
	Living with Spouses and Children	20 15.9%
	Others	11 8.8%
<b>Barthel Activity of Daily Living</b>	M: 18.6	SD: 2.54
<b>Geriatric Depression Scale</b>	M: 3.58	SD: 3.39



**Figure 1:** Changes of mean of health literacy scores over time.

Note. T1 = Time 1; T2 = Time 2; T3 = Time 3; T4 = Time 4

**Table 2: Comparison of mean health literacy scores over time using Generalized Linear Mixed Method (GLMM).**

	Estimate	P-value
<b>Health Literacy</b>		
Time 4 – Time 1	5.073	0.014
Time 4 – Time 3	2.742	0.003
Time 2 – Time 1	2.062	0.407

**Table 3: Distribution of medication adherence scores over time.**

Time	MMAS level	MMAS Score	n	%
T1	1	<6	30	23.44%
	2	6-7	68	53.13%
	3	8	30	23.44%
T2	1	<6	18	16.22%
	2	6-7	73	65.77%
	3	8	20	18.02%
T3	1	<6	30	23.62%
	2	6-7	64	50.39%
	3	8	33	25.98%
T4	1	<6	17	16.04%
	2	6-7	56	52.83%
	3	8	33	31.13%

It showed that the two interventions (VAEL and CBs) conducted by trained volunteers were effective to improve both health literacy and medication adherence among persons with MCI. Simply using VAEL did not make any change in health literacy; however, by adding CBs, MCI persons showed significant improvement in their ability to receive and interpret the relevant health information on drug labels.

Persons with MCI reported many barriers in medication taking. The most common reported barriers were: having difficulty in remembering the amount or time of each medication (49%) and difficulty in reading the instructions on prescription bottles (42%) [18]. These difficulties were not only encountered by persons with MCI, but also encountered by those with normal cognition [18]. However, to the persons with MCI, remembering word-for-word is even more demanding than those with normal cognition. Existing drug labels are all written in ‘words’ that do not support memory, understanding and interpretation.

This study introduced an innovative strategy – comic books to improve individuals’ understanding and interpretation of the instructions on drug labels, and improve their medication adherence. The use of pictures in comic books supports individuals’ gist memory that is, remembering the general meaning of things [19]. Gist memory encourages individuals to capture meaning, or remember the essential meaning, the “substance” of information, rather than exact words, numbers, or pictures. A recent experimental study showed that gist-based conceptual processing of pictures was preserved in persons with MCI, supporting the persons to extract and use gist information [20]. Therefore,

controlling age, the chance of moving MMAS level one level higher than its original level at T4 was high (O.R.=3.316, S.E. 0.2979, 95% CI 0.650-1.747, p<0.001) (Table 4). Similarly, the chances of improving medication adherence at T3 (O.R.=2.295, S.E. 0.2576, 95% CI 0.326-1.335, p=0.001) and T2 (O.R.=2.506, S.E. 0.2645, 95% CI 0.400-1.437, p=0.001) were about two times more than the one at T1 (Table 4).

**Conclusion**

To the best understanding of the project team, this study is the first interventional study addressing medication taking among persons with MCI.

**Table 4: Estimating the chance of improving medication adherence by General Estimating Equation (GEE).**

Parameter		Odds Ratio	Std. Error	95% Confidence Interval		Hypothesis Test		
				Lower	Upper	Wald Chi-Square	df	p value
Threshold	MMAS_level=1	0.169	1.2276	-4.185	0.627	2.101	1	0.147
	MMAS_level=2	3.053	1.2214	-1.278	3.510	0.835	1	0.361
Age		0.985	0.0148	-0.044	0.014	1.036	1	0.309
Time 4		3.316	0.2797	0.650	1.747	18.363	1	<0.001
Time 3		2.295	0.2576	0.326	1.335	10.397	1	0.001
Time 2		2.506	0.2645	0.400	1.437	12.067	1	0.001
Time 1		ref.						

*Note.* MMAS level 1 referred to the MMAS score lower than 6, indicating 'poor adherence'; MMAS level 2 referred to the MMAS score 6 to 7, indicating 'medium adherence'.

pictures have superiority effect on understanding and retrieving information [20].

Misunderstanding and misinterpretation of dosage instructions on drug labels is common. A study showed that the rates of correct interpretation of the eight warning instructions on drug labels varied: from 0% to 78% [21]. This meant that some people knew nothing about the warning instructions on the drug labels after reading, and although some were able to interpret the information from the drug labels, they could understand only 78% of the content, at most. The majority of older adults in Hong Kong are illiterate or have a low education level, so they are at particular risk of misunderstanding information on drug labels and misusing medication.

This study has several limitations: Firstly, this study did not include a control group for comparison. More research with better design is warranted. Secondly, the two interventions were separated with a wash out period of one year. We assumed there were no significant changes in the participants' physical and mental health status. Caution should be taken when interpreting these findings.

As a conclusion, the current study provided encouraging results to support medication taking among persons with MCI. Trained volunteers giving verbal advice according to the standardized protocol, using an educational leaflet and health literacy-oriented comic books seemed to effectively improve health literacy and medication adherence. Since inadequate health literacy was interconnected with poor medication adherence [22], an intervention to improve both health literacy and medication adherence is worthy to be supported.

#### Declaration

Part of the findings was presented in the

International Alzheimer's Disease Conference 2017 in Hong Kong Science Park, Hong Kong on 25 May 2017.

#### Acknowledgments

*The authors wish to acknowledge the invaluable contribution of the participants and the Medication Use Supportive Team (MUST) members. Special thanks go to Mr. Alex Kwan, Mr. Godfrey Lam, Ms. Cynthia Ng, Ms. Joyce Hui, Ms. Karen Tam and all estate managers of the 15 public estates for their kind support and assistance in data collection, and the anonymous reviewers for their thoughtful review and guidance.*

#### Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available as the release of the dataset in public domain may compromise research participants' privacy but the datasets are available from the corresponding author on reasonable request.

#### Authors' contribution

AYM Leung contributed to the study design, application for ethical approval, data collection, statistical analyses, and interpretation of the findings, intellectual input, and revision of the manuscript. S Lo contributed to data collection and interpretation of the findings. I Leung contributed to paper drafting, data collection and data analysis. J Liu and S Ting contributed to study design, data collection, and interpretation of the findings. All authors read and approved the final manuscript.

#### Funding

This project was supported by Hong Kong

Housing Society (HKHS) 2016-2018.

### Competing interests

The authors declare that they have no competing interests.

### Consent for publication

Not applicable.

### Ethics approval and consent to participate

Ethical approval was obtained from The University of Hong Kong/The Hospital Authority's Hong Kong Island West Cluster Institutional Review Board (UW 15-545) and the Hong Kong Polytechnic University Human Subjects Ethics Review Subcommittee (ref. no.: HSEARS20160913002-01). Informed written consent was obtained from all participants of the study.

### References

1. U.S Department of Health and Human Services - Office of Disease Prevention and Health Promotion. Quick guide to health literacy (2005).
2. Wolf MS, Gazmararian JA, Baker DW. Health literacy and functional health status among older adults. *Arch. Intern. Med* 165(17), 1946-1952 (2005).
3. Leung AYM, Kwan CW, Leung I, et al. Inadequate health literacy and more hospitalisation among frail older adults in Hong Kong. *Asian. J. Geront. Geriatr* 11(1), 10-13 (2016).
4. Bennett IM, Chen J, Soroui JS, et al. The contribution of health literacy to disparities in self-rated health status and preventive health behaviors in older adults. *Ann. Fam. Med* 7(3), 204-211 (2009).
5. McNaughton CD, Cawthon C, Kripalani S, et al. Health Literacy and Mortality: A cohort study of patients hospitalized for acute heart failure. *Am. Heart. Assoc* 4(5), e001799 (2015).
6. Jackson D. A myriad of multiples: many problematic factors contribute to medication non-adherence in elders. *Generations* 35(4), 31-36 (2012).
7. Kripalani S, Gatti ME, Jacobson TA. Association of age, health literacy, and medication management strategies with cardiovascular medication adherence. *Patient. Educ. Couns* 81(2), 177-181 (2010).
8. Zhang NJ, Terry A, McHorney CA. Impact of health literacy on medication adherence: a systematic review and meta-analysis. *Ann. Pharmacother* 48(6), 741-51 (2014).
9. Jones JH, Treiber LA, Matthew CJ. Intervening at the intersection of medication adherence and health literacy. *J. Nurse. Pract* 10(8), 527-534 (2014).
10. Davis TC, Federman AD, Bass PF, et al. Improving patient understanding of prescription drug label instructions. *J. Gen. Intern. Med* 24(1), 57-62 (2009).
11. Shiyanbola OO, Meyer BA, Locke MR, et al. Perceptions of prescription warning labels with an undeserved population. *Pharm. pract* 12(1), 387 (2014).
12. Mayo clinic. Mild cognitive impairment (2017).
13. Morisky D, Green L, Levine D. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med. Care* 24(1), 67-74 (1986).
14. Pedersini R, Isherwood G, Vietri J. Harmonizing measurement of adherence across the 4-Item and 8-Item Morisky Medication Adherence Scale using cross-sectional data from patients treated for irritable bowel syndrome. *Value. Health* 16(7), A604 (2013).
15. Leung AYM, Cheung MKT, Lou VWQ, et al. Development and validation of the Chinese Health Literacy Scale for chronic care. *J. Health. Commun* 18(Suppl1), 205-222 (2013).
16. Leung SO, Chan CC, Shah S. Development of a Chinese version of the Modified Barthel Index-validity and reliability. *Clin. Rehabil* 21(10), 912-22 (2007).
17. Wong A, Xiong YY, Kwan PW, et al. The validity, reliability and clinical utility of the Hong Kong Montreal Cognitive Assessment (HK-MoCA) in patients with cerebral small vessel disease. *Dement. Geriatr. Cogn. Disord* 28(1), 81-87 (2009).
18. Campbell NL, Zhan J, Tu W, et al. Self-reported medication adherence barriers among ambulatory older adults with mild cognitive impairment. *Pharmacotherapy* 36(2), 196-202 (2016).
19. Brainerd CJ, Reyna VF. Fuzzy-trace theory and false memory. *Curr. Direct. Psycho. Sci* 5(11) (2002).
20. Deason RG, Hussey EP, Budson AE, et al. Gist-based conceptual processing of pictures remains intact in patients with amnesic mild cognitive impairment. *Neuropsychology* 26(2), 202-208 (2012).
21. Wolf MS, Davis TC, Tilson HH, et al. Misunderstanding of prescription drug warning labels among patients with low literacy. *Am. J. Health. Syst. Pharm* 63(11), 1048-1055 (2006).
22. Lee YM, Yu HY, You MA, et al. Impact of health literacy on medication adherence in older people with chronic diseases. *Collegian* 24(1), 11-18 (2017).