ORIGINAL RESEARCH

The use of potentially inappropriate medications and changes in quality of life among older nursing home residents

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Background: Nursing home residents are mainly older people with multiple diseases and taking multiple medications. The quality use of medication and its association with health related quality of life (HRQoL) have not been reported in Malaysia. This study aims to investigate the association between the use of potentially inappropriate medications (PIMs) and the changes observed in the HRQoL among older nursing home residents.

Methods: A prospective follow up study was conducted at four nongovernmental organization nursing homes in Penang, Malaysia. Older residents ($\geq$65 years old) taking at least one prescribed medication were included. Residents with PIMs were identified by using Screening Tool of Older Person's potentially inappropriate Prescriptions (STOPP) criteria. HRQoL was assessed using EuroQol-5 dimension (EQ-5D) and EuroQol-visual analog scale (EQ-VAS) at baseline and after a 3-month follow up. The association of PIMs with HRQoL was analyzed using Mann-Whitney U test.

Results: The median age of the 211 participants was 77 years (interquartile range 72–82 years) and the median number of prescription medicines was four (interquartile range three to six). The prevalence of PIMs was 23.7% and 18.6% at baseline and 3 months later, respectively. The most commonly prescribed PIMs in decreasing order were first generation antihistamine, prescriptions of duplicate drug class, glibenclamide with type 2 diabetes mellitus, and anticholinergic to treat extrapyramidal side effects of neuroleptic medications. At baseline, there was no significant difference among residents with or without PIMs in each bracket of EQ-5D, EQ-5D index, or EQ-VAS scores. Comparison of the differences in the mean score index of EQ-5D between baseline and after 3 months also showed no statistically significant differences.

Conclusion: PIMs were found to be relatively common among older nursing home residents. However, no significant changes were observed in HRQoL among these residents. Further studies with a bigger sample size and longer follow up period are required to establish this association.

Keywords: elderly, health related quality of life, patient safety

Introduction

Aging has become an emerging health problem and is considered the most challenging health issue worldwide. Advances in technologies and the development of new medicines have contributed longer life expectancy. It has been reported that 90% of the older population in the US have been using at least one medication.[1] The complex process of aging, which causes changes in physiological function, can affect the pharmacodynamics and pharmacokinetics of the medication taken by older populations.[2] In addition, the use of multiple medications due to multiple comorbid conditions may also lead to the use of potentially inappropriate medications (PIMs), which place medication users at higher risk for adverse drug reaction.

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PIM has been defined as the use of medication with risk greater than benefit, inappropriate dosing duration, prescriptions that lead to clinically significant drug–drug and drug–disease interactions, and the under-use of potentially beneficial medications.[3] PIMs among the older population have continued to be a significant problem worldwide.[4,5] This scenario is particularly common among nursing home residents due to the high prevalence of frailty, multiple comorbidities, and functional limitations.[6] PIMs have been reported to be common among the elderly with a prevalence of 40%–50% among nursing home residents[7,8] and 19%–28% among community dwelling patients.[7,9,10]

In Malaysia, the number of institutions for the elderly is increasing. There are few residential homes and long-term care facilities that are fully funded by the government. The majority of nursing homes are operated by private sector and nongovernmental organizations with some financial support from the government. There are no dedicated physicians and/or pharmacists working in the nursing homes to provide continuous medical care. Also, routine medication review processes are not being conducted in nursing homes in Malaysia as they are in other developed countries. The residents are sent to either government hospitals or primary health care clinics for medical treatment. Patients with chronic diseases are under regular monitoring in specialized clinics in hospitals.

Health related quality of life (HRQoL) is now considered as an essential outcome measure for assessing the effectiveness of medical intervention. A study, which was conducted using the database from the 1996 Medical Expenditure Panel Survey, has shown that PIM is a predictor for and is associated with poor patient HRQoL.[11] Recent studies have shown a significant improvement in HRQoL among patients who are taking safer and more appropriate drugs.[12,13] From the local perspective, there is only one study that has been recently published on PIMs use among older populations.[14] The prevalence of PIMs use among nursing home residents was reported to be high at 32.7% using Beers criteria.[14] However, no data have been reported focusing on the changes of HRQoL among older people prescribed with PIMs. Hence, the current study aims to investigate the association between the use of PIMs and the changes observed in the HRQoL among older nursing home residents.

Materials and methods
Study design and setting
A prospective follow-up study was conducted at four non-governmental nursing homes in Penang, Malaysia.

The study was divided into two phases. In Phase I of the study, the baseline data from all the nursing homes were collected over a 2 month period from January 2011 through February 2011. Each recruited patient from Phase I of the study was followed up after a 3 month period (Phase II). The PIMs and HRQoL were reassessed after a period of 3 months. All residents of 65 years of age or over with nursing home stay for at least 3 consecutive months and who were taking at least one prescribed medication for 7 days prior to the recruitment were included in the study. The exclusion criteria were residents with medical diagnoses of dementia (or those taking antidementia drugs), those who refused to participate in the study, or those who were unable to participate in the study due to delirium or were unable to respond, communicate, and present with complete cognitive and functional disability.

The demographic, clinical, and medications data of residents were collected using medical records review and interviews of residents where necessary. Functional status for residents was assessed using Katz activities of daily living.[15] This scale reflects dependence in six primary functions, ie, bathing, dressing, toileting, continence, walking, and eating. The scores of this scale ranges from 0 (independence) to 6 (high dependency).

The cognitive status
The cognitive function of the residents was screened using the Mini-Cog exam,[16] which is a tool comprising three-item recall and the clock drawing test (CDT) with sensitivity ranging from 76%–99%, and specificity ranging from 89%–93%. Patients who fail to recall all three items after the CDT distractor are classified as possibly demented. The residents who are able to recall one or two of the items are classified based on the CDT. An abnormal CDT equates with possibly demented and a normal CDT is considered normal and equates with non-demented. The Mini-Cog was developed as a screening tool to identify patients with possible dementia. The Mini-Cog tool was not used as an exclusion tool in this study.

Health related quality of life
All residents who fulfill the inclusion criteria were assessed at baseline for HRQoL using the EuroQoL tool, which comprised of EuroQol-5 dimension (EQ-5D) and EuroQol-visual analog scale (EQ-VAS).[17] The first part is considered a descriptive system that is used to evaluate health function in 5 dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression). The results were

classified based on the scoring system categorized as: no problem (score 1); some problem (score 2); and extreme problem (score 3). In addition, the results can be identified for each domain separately. Moreover, the EuroQol index is a single weighted health index, which was converted from 243 possible combinations of health states by applying the weights from the York tariffs.[18] Values of the EuroQol index can range from −0.594 to 1 and a negative index score implies a quality of life worse than death.

The second part is a self-administered EQ-VAS used to evaluate current and general health status. The residents were asked to assess their health status by drawing a line from a box that represents "your health status today" to a point on EQ-VAS that represents heath status. A score of 100 indicates the best health status, while a score of zero indicates the worst health status.[17] Permission was obtained from the EuroQoL group to use both the English and Malay versions of the EQ-5D. Both versions have been validated for use among Malaysian populations.[19]

Potentially inappropriate medications

PIMs use in this population was assessed using the Screening Tool of Older Person's potentially inappropriate Prescriptions (STOPP) criteria[20,21] at baseline and after a period of 3 months. Residents' medications in the last 7 days prior to interview were assessed for the identification of PIMs. STOPP is a tool used to identify PIMs and potential adverse drug reactions among older people. It consists of 65 clinically significant criteria for PIM. For the convenient use of the criteria, arrangements of medications are carried out according to relevant physiological systems. Inter-rater reliability of STOPP criteria is good, with a kappa coefficient of 0.75.[20]

Statistical analysis

The comparison of the differences in the baseline variables between the PIM and non-PIM group was conducted using Student's *t*-test for normally distributed data, Pearson's chi-squared test was used for categorical data, and Mann-Whitney *U*-test was used for non-normally distributed data. Unpaired *t*-test was used to measure the change in the quality of life ([QOL] ∆QOL = QOLs after 3 months minus baseline QOLs) between the PIM group and non-PIM group, and to evaluate whether PIMs affected individual baseline of QOLs during the 3 month follow-up. In addition, chi-square test was used to compare the changes of PIMs at baseline and 3 months later. The data were analyzed using PASW® (Predictive Analytics SoftWare) Statistics 18.0 (SPSS Inc., Chicago, IL, USA).

Ethics approval

This study was approved by the local ethics committee (Medical Research and Ethics Committee [MREC], Ministry of Health, Malaysia), and carried out in accordance with the Declaration of Helsinki.

Results

Of the total population (n=460) residing in four nursing homes, 211 (45.7%) residents were included in the study. The remaining 249 residents were excluded for the following reasons: residents not able to participate due to delirium or unable to respond to interview questions [n=91], <65 years old (n=11), not taking any prescribed medications (n=77), less than 3 month stay in a nursing home (n=2), diagnosis of dementia (n=32), and those who refused to participate (n=36). During the follow up period (Phase II), 12 residents were excluded from this study for reasons such as leaving home or on holiday (n=5), hospitalized due to fall and vascular ulcer (n=2), not able to participate (n=2), and death (n=3).

The baseline characteristics of the study subjects are listed in Table 1. The median age is 77 years (interquartile range 72–82 years). The study's participants were mainly females (60.7%). The most common comorbidities among participants were hypertension (71.1%) followed by diabetes mellitus (27.1%), stroke (12.3%), osteoarthritis (11.8%), and ischemic heart disease (7.1%). The median number of medications prescribed was four (range of one to 14) from a total of 989 medications.

The prevalence of PIMs identified by STOPP criteria at baseline was 23.7%; 64 PIMs affecting 50 residents. Eleven residents (5.2%) were taking more than one PIM. The most common PIMs detected were first generation antihistamine (23.4%), followed

Table 1 The characteristics of residents included in the study

Demographics	n (%)
Total sample included in the study	211
Female	128 (60.7)
Age, mean (years ± SD)	77.7±7.0
Number of drugs prescribed, mean (number ± SD)	4.7±2.8
Median number of drugs per patient (IQR)	4 (3–6)
Mean number of diagnoses (± SD)	2.3±1.2
Number of years residing in the nursing home	6.7±4.1
Number of residents who are currently smokers	21 (10.0)
Total years of education (0–6 years)	167 (79.2)
Number of residents who are single	143 (67.8)
Polypharmacy (≥5 drugs)	93 (44.0)
Number of residents who are self-administrating medications	84 (39.8)
Mean ADL ± SD	5.3±1.6
Number of residents with Mini-Cog score ≤2	129 (61.0)

Abbreviations: ADL, activities of daily living; IQR, interquartile range; SD, standard deviation.

by prescriptions of duplicate drug class (including two angiotensin receptor blockers, two first generation antihistamines, and alpha-2 blockers) (15.6%), glibenclamide or chlorpropamide with type 2 diabetes mellitus (10.9%), and anticholinergic to treat extrapyramidal side effects of neuroleptic medications (9.4%). Other less common medications were prolonged use (>1 week) of first generation antihistamines (7.8%), benzodiazepines (4.7%), and neuroleptics (1.7%) as shown in Table 2. Reassessment of PIMs after 3 months showed that there was a decrease in the prevalence of PIMs to a prevalence of 18.6%, affecting 37 residents. The prevalence of residents who were still taking PIMs was 15.2% (n=32), while 7.1% (15) of the residents stopped taking PIMs. However, 2.4% (n=5) of residents had added PIMs. The number of prescribed medications in Phase II decreased from 989 at baseline to 911.

Pearson's chi-squared test analysis was used to assess the association between PIMs with the 5 dimensions of EQ-5D at baseline. Results showed that there were no significant differences in all of the 5 dimensions among residents with and without STOPP PIMs (Table 3). Similar findings were found for both EQ-5D index and EQ-VAS. Table 4 shows that there were no significant differences in HRQoL measured by

EQ-5D index (P=0.135) and by EQ-VAS (P=0.666) among residents with and without PIMs.

The changes in HRQoL among residents with PIMs were assessed by comparing differences in the mean score index of EQ-5D and EQ-VAS between baseline and the 3 months follow-up period. No significant differences were seen in EQ-5D score (P=0.07) and EQ-VAS score (P=0.34) among residents with STOPP PIMs and without STOPP PIMs (Table 5).

Discussion

Several published studies have in fact reported the relationship between HRQoL and the use of PIMs.[11,12,22,23] All of these studies were conducted in either hospitals or ambulatory care settings, but none of them focused on a nursing home setting in Malaysia, in particular. This study shows that the rate of PIMs was lower (23.7%) compared to other studies. A study that was conducted across different health care settings using STOPP criteria in Spain reported higher prevalence; 36% in a public primary clinic, 54% a in hospital geriatric clinic, and 50% in assisted nursing homes.[24] Different prescribing practices tailored to local health care

Table 2 STOPP potentially inappropriate medications

STOPP PIMs	Baseline, n (%)	After 3 months, n (%)
First generation antihistamines (falls in the past 3 months)	15 (23.4)	8 (19.5)
Any regular duplicate drug class prescription	10 (15.6)	4 (9.8)
Glibenclamide or chlorpropamide with type 2 diabetes mellitus	7 (10.9)	7 (17.1)
Anticholinergics to treat extrapyramidal side-effects of neuroleptic medications	6 (9.4)	4 (9.8)
Prolonged use (>1 week) of first generation antihistamines	5 (7.8)	8 (19.5)
Loop diuretic for dependent ankle oedema only, ie, no clinical signs of heart failure	4 (6.3)	3 (7.3)
Theophylline as monotherapy for chronic obstructive pulmonary disease	3 (4.7)	3 (7.3)
Benzodiazepines (falls in the past 3 months) (sedative, may cause reduced sensorium, impair balance)	3 (4.7)	–
Neuroleptic drugs (falls in the past 3 months)	1 (1.7)	–
Thiazide diuretic with a history of gout	1 (1.7)	1 (2.4)
NSAIDS with history of peptic ulcer disease or gastrointestinal bleeding, unless with concurrent histamine H_2 receptor antagonist, PPI, or misoprostol	1 (1.7)	1 (2.4)
Long-term (ie, >1 month) long-acting benzodiazepines, eg, chlordiazepoxide, fluazepam, nitrazepam, chlorazepate, and benzodiazepines with long-acting metabolites, eg, diazepam	1 (1.7)	1 (2.4)
Aspirin with a past history of peptic ulcer disease without histamine H_2 receptor antagonist or PPI	1 (1.7)	–
Beta-blockers in those with diabetes mellitus and frequent hypoglycemic episodes, ie, one episode per month	1 (1.7)	–
Warfarin and NSAIDS together	1 (1.7)	–
Long-term use of NSAIDS (>3 months) for relief of mild joint pain in osteoarthritis (simple analgesics preferable and usually as effective for pain relief)	1 (1.7)	–
Long-term NSAIDS or colchicine for chronic treatment of gout where there is no contraindication to allopurinol (allopurinol first choice prophylactic drug in gout)	1 (1.7)	–
NSAIDS with heart failure (risk of exacerbation of heart failure)	1 (1.7)	1 (2.4)
Use of aspirin and warfarin in combination without histamine H_2 receptor antagonist (except cimetidine because of interaction with warfarin) or proton pump inhibitor (high risk of gastrointestinal bleeding)	1 (1.7)	–
Total	64 (100.0)	41 (100.0)

Abbreviations: NSAIDS, nonsteroidal anti-inflammatory drugs; PIMs, potentially inappropriate medications; PPI, proton pump inhibitor; STOPP, Screening Tool of Older Person's potentially inappropriate Prescriptions.

Table 3 Frequency of reported problems by dimensions in residents with and without STOPP PIMs at baseline

EQ-5D dimensions	STOPP PIMs, n (%)		Total, n	P-value
	With	Without		
Mobility				
No problems	22 (21.2)	82 (78.8)	104	0.392
Problems	28 (26.2)	79 (73.8)	107	
Self-care				
No problems	28 (21.5)	102 (78.5)	130	0.350
Problems	22 (27.2)	59 (72.8)	81	
Usual activities				
No problems	26 (21.8)	93 (78.2)	119	0.473
Problems	24 (26.1)	68 (73.9)	92	
Pain/discomfort				
No problems	16 (22.2)	56 (77.8)	72	0.717
Problems	34 (24.5)	105 (75.5)	139	
Anxiety/depression				
No problems	35 (22.0)	124 (78.0)	159	0.314
Problems	15 (28.8)	37 (71.2)	52	

Abbreviations: EQ-5D, EuroQol-5 dimension; PIMs, potentially inappropriate medications; STOPP, Screening Tool of Older Person's potentially inappropriate Prescriptions.

systems and the number of medications may explain the variations observed. The number of prescriptions has been identified as a significant predictor of inappropriate use of medications and HRQoL.[23,25] The population of this study was taking a median of four medications, which is slightly lower compared to the ones taken in the developed countries. For example, in an Australian study, the average number of medications utilized by elderly residents was seven.[26] Hence, the low rate of medication use may contribute to the lower rate of PIMs observed.

During the follow-up phase, lower prevalence of PIMs was observed in this study compared to baseline (18.6% versus 23.7%, respectively). This could be due to the decrease in the utilization of prescribed medications during the follow-up phase. First generation antihistamine was still identified as the most common prescribed PIM although it was the most common stopped PIM during the 3 month follow-up. A decrease of PIMs cases classified as drug duplications was noticed.

Table 4 HRQoL for those residents with STOPP PIMs compared to those without STOPP PIMs at baseline

Quality of life outcomes	STOPP PIMs (n=50)	Non-STOPP PIMs (n=161)	P-value
EQ-5D index median (IQR)	0.701 (0.516–0.796)	0.727 (0.587–0.796)	0.135
EQ-VAS median (IQR)	81.00 (60–99)	80.0 (70–99)	0.666

Abbreviaitons: EQ-5D, EuroQol-5 dimension; EQ-VAS, EuroQol-visual analog scale; HRQoL, health related quality of life; IQR, interquartile range; PIMs, potentially inappropriate medications; STOPP, Screening Tool of Older Person's potentially inappropriate Prescriptions.

PIMs due to glibenclamide prescriptions with type 2 diabetes mellitus remained the same in terms of numbers (seven cases) although the percentage was higher in Phase II than at baseline (17.1% versus 10.9%, respectively).

The main result of this study showed no statistically significant association between PIMs and HRQoL. PIMs showed no statistical significant differences based on any EQ-5D descriptive system and EQ-VAS score at baseline and after 3 months. The HRQoL was comparable among residents with and without PIMs. On average, the EQ-5D and EQ-VAS score was above 0.60 and 70, respectively. In a study conducted among older community dwellers, a higher EQ-5D index (0.7) was reported compared to the current study, but a similar EQ-VAS score was reported.[23] The discrepancy could be due to better health status of their study population, which consists of a general population of noninstitutionalized individuals compared to a nursing home population in the present study. However, the same EQ-VAS value can be due to individual perception of the current residents' health status in this study, which was largely influenced by many factors including better self-acceptance of health conditions among nursing home residents.

Another study by Olsson et al examined the association between medication qualities measured by the medication appropriateness index and HRQoL measured by the EQ-5D in a group of elderly people discharged from hospitals.[12] Their study population achieved a lower score compared to this study; mean EQ-5D <0.5 and mean EQ-VAS <60. Hospitalized patients would have slightly lower HRQoL because they were admitted for acute medical conditions and may have loss of activities of daily living during the recuperation period. One study has shown that hospitalizations were associated with functional decline among elderly patients.[27] Consequently, these may have lowered the EQ-5D measurement on HRQoL.

Although the majority of the studies do not show any significant difference or a relationship between PIMs and HRQoL,[22,23] one study, which employed one question on global self-rated health status, showed a significant decrease in self-perceived health status in the elderly.[11] This result was mainly attributed to the tool used for the outcome measurement. Although the method utilized may contribute for estimation bias, it was reported that the tool was widely used with proven predictive validity and substantial reliability in epidemiological research.[11]

One group of researchers suggested that the use of the disease-specific HRQoL scale might provide more specific and receptive results for the measurement of the impact of

Table 5 Mean EQ-5D scores and visual analog health scale scores for groups at baseline and 3 months follow-up

Measure	STOPP PIM group score (SD)	Non-STOPP PIM group score (SD)	Difference* in change over 3 months, with 95% CI and *P*-value†
EQ-5D			
Baseline	0.58 (0.38)	0.66 (0.31)	
3 months	0.46 (0.43)	0.62 (0.35)	
Change over 3 months	−0.12 (0.28)	−0.04 (0.25)	0.08 (−0.007 to 0.17; *P*=0.07)
EQ-VAS			
Baseline	77.1 (21.6)	79.0 (20.6)	
3 months	76.5 (17.0)	75.7 (19.3)	
Change over 3 months	−1.17 (20.9)	−4.40 (20.2)	−3.22 (−9.93 to 3.48; *P*=0.34)

Notes: *STOPP PIM group score minus Non-STOPP PIM score; †*t*-tests were used to compare the difference in change over 3 months.
Abbreviations: CI, confidence interval; EQ-5D, EuroQol-5 dimension; EQ-VAS, EuroQol-visual analog scale; PIM, potentially inappropriate medication; SD, standard deviation; STOPP, Screening Tool of Older Person's potentially inappropriate Prescriptions.

PIMs towards patient's HRQoL.[23] Such argument was on the basis that generic quality of life measures may not be sensitive to nonsevere illnesses. However, there are no data from the literature to support this statement. The use of EQ-5D to assess HRQoL is considered as a point of strength in this study. It is a standardized measure of health status developed by the EuroQol Group that is applicable to a wide range of health conditions and treatments with a simple descriptive profile and a single index value for health status. It is cognitively undemanding, taking only a few minutes to complete. Wolfs et al showed that the EQ-5D is well suited for evaluating HRQoL among population with cognitive impairment.[28] In a recent study, EQ-5D was found to be user friendly and a potential predictor of mortality and first hospitalization among the elderly.[29] Although regional variation in term valuations or weightings may contribute to different outcomes, it should not be considered as a major limitation. The author adopted the EQ-5D index derived from the UK population due to unavailability of local term valuation. The application of the valuations among a Malaysian population may differ due to dissimilar sociodemographic characteristics and cultural perceptions towards health status.

The strength of this study lies in the high reliability for all assessments as they were conducted only by one researcher. All interviews were conducted in English, Malay, or, when necessary, with the most appropriate dialect with an assigned interpreter. The researcher followed a script that was used to ensure consistency when assessing the residents.

Although the study was conducted using a robust method, there are several limitations that are worth mentioning here. First, small sample size may have contributed to the result observed in the HRQoL. The current findings could not be generalized to the entire Malaysian elderly population due to the special population group limited to nursing homes. Although this study was a multicenter study,

it focused on one state only in Northern Malaysia. Second, the lower prevalence of PIMs identified could be due to under reporting due to older residents with the diagnosis of dementia being excluded in this study; demented patients are reportedly more prone to be prescribed with PIMs.[30] Third, the researchers did not perform the under-treatment assessment among the nursing homes, which can affect the rate of PIMs and the consequent change in HRQoL. Finally, inclusion of four centers may lead to variation of the PIMs rate due to different prescribing patterns from different hospitals and clinicians.

Conclusion

This study indicates that PIMs are relatively prevalent in the Malaysian nursing homes as detected by STOPP criteria. Although there were no statistically significant changes observed in terms of the HRQoL among the nursing home residents, the study does provide baseline information and challenges faced in terms of the quality use of medications. A larger study with a longer follow-up period should be conducted throughout Malaysia to give more insight into this issue. Aside from this, new policies should be implemented implicating the involvement of pharmacists to provide a routine comprehensive medication review in the nursing homes to improve medication use among the elderly.

Acknowledgments

Disclosure

The authors report no conflicts of interest in this work.

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