Quality of Life Research (2019) 28:1913–1920
https://doi.org/10.1007/s11136-019-02153-5

Does inappropriate prescribing affect elderly patients' quality of life? A study from a Malaysian tertiary hospital

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Accepted: 25 February 2019 / Published online: 4 March 2019

Abstract

Purpose To investigate the association between potentially inappropriate medication (PIM)/potential prescribing omission (PPO) and the health-related quality of life (HRQoL) among community-dwelling hospitalized elderly patients.

Methods This is a cross-sectional study that took place in a Malaysian tertiary hospital. Patients ≥ 65 years old with at least one medication on admission were recruited. The patients' prehospitalization medications were reviewed to identify PIMs/PPOs using version 2 of the STOPP/START criteria. HRQoL was assessed using the EuroQol-5 dimensions (EQ-5D) and EuroQol-visual analog scale (EQ-VAS). The association between the presence of PIM/PPO and the patients' HRQoL was analyzed using Chi-square and Mann–Whitney U tests. Multiple linear regression models were applied to determine the effect of exposure to PIM/PPO on the patients' HRQoL, adjusting for confounders.

Results Out of 517 patients who fulfilled the inclusion criteria, 502 patients (97%) accepted to be involved in the study and completed the HRQoL questionnaire. The mean (SD) age was 72.4 (5.9) years. 393 (78.3%) of the patients had problems in at least one EQ-5D dimension with pain/discomfort problem being the most reported complaint. The mean (SD) values of the EQ-5D index and the EQ-VAS were 0.734 (0.214) and 59.6 (14.2), respectively, which are lower than those seen in the general Malaysian population. PIM and PPO were found in 28.5% and 45.6% of the patients, respectively. No significant differences were found in the EQ-5D dimensions, EQ-5D index and EQ-VAS between patients who had PIM/PPO and those who did not. Age, sex, and comorbidities were significantly associated with the patients' HRQoL.

Conclusion PIM and PPO are not uncommon among hospitalized elderly patients; however, it does not significantly affect their HRQoL as measured by the EQ-5D-3L instrument.

Keywords Potentially inappropriate prescribing · Health-related quality of life · Elderly patients · Hospitalization · EQ-5D-3L

Introduction

The aging process is usually associated with several negative aspects; like loss of function, decreased autonomy, reduced memory, high dependency on caregivers, and an increase in the number of diseases. These changes interfere with the patient's quality of life [1]. Health-related quality of life (HRQoL) describes the self-perception of well-being that is specifically affected by aspects related to health [2]. HRQoL is currently considered as an essential health outcome to evaluate the success of medical interventions. As a result, the United States Department of Health and Human Services added HRQoL measures to the national surveys to assess public health [3].

The overall goal of healthcare is *"to help people live longer and feel better"* [4]. Modern drugs contribute significantly to achieving the goal above. Nonetheless, the side effects associated with the increasing use of medications negatively impact the patients' quality of life [1, 5]. Potentially inappropriate prescribing (PIP) happens either when the risks associated with giving a medication outweigh the expected benefits, which is termed potentially inappropriate medication (PIM), or when a specific medication is indicated

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but not prescribed, which in turn is called potential prescribing omission (PPO) [6]. PIP is associated with an increasing incidence of adverse drug reactions (ADRs) and medication-related hospitalization [7, 8]. Therefore, PIM and PPO are expected to be associated with a reduction in the HRQoL, particularly in elderly patients. Several studies demonstrated the relationship between the quality of medications and the quality of life in older people, where the presence of PIP was linked to a lower HRQoL [1, 9, 10]. On the other hand, some other studies failed to prove this relationship [3, 11, 12].

In Malaysia, data revealed that PIP is prevalent in different healthcare settings. A study on community-dwelling older adults found that 31.8% of the participants had at least one PIM according to Beers criteria [13]. Also, a report from a hospital setting portrayed a high prevalence (52.8%) of prescribing PIMs during hospitalization [14]. Another study from nursing homes reported a prevalence of PIM ranging from 23.7 to 32.7% with no impact on the residents' HRQoL [12]. To our knowledge, there are no studies that addressed the possible relationship between the PIP and HRQoL among hospitalized elderly patients in Malaysia. The objective of the current study is to investigate the association between the presence of PIM or PPO and the HRQoL among community-dwelling hospitalized elderly patients.

Methods

Study design and setting

This is a cross-sectional study that took place in the multidisciplinary medical and surgical wards of Hospital Tengku Ampuan Afzan (HTAA), Kuantan, Pahang, Malaysia from April to October 2016 and from April to October 2017. The total capacity of the two involved wards was 326 beds.

This study is a part of a larger project which consisted of three phases: (1) An observational study from April to October 2016, (2) An educational intervention from November 2016 to February 2017, and (3) Another observational study from April to October 2017. The main objective of the large study was to investigate the impact of the educational intervention on the appropriateness of discharge medications as defined by the STOPP/START criteria. This article focuses only on the prehospitalization medications of the patients, and for this reason, the two groups of patients in the two observational studies were combined together.

Study population

Patients of 65 years and above who were admitted to the hospital from community settings, for any medical or surgical reason, and who were on at least one chronic medication (a medication that has been used for ≥ 3 months) before their hospitalization, were considered eligible. Patients were excluded if they had a medical condition that is known to reduce their HRQoL significantly; this includes cancer, dementia, psychiatric disorders, and musculoskeletal injuries such as fractures. Patients were also excluded if they had been living in long-term care facilities (e.g., nursing homes), could not speak or were unable to communicate in English or Malay, or if their prehospitalization medications were not clearly stated in their records.

Sample size

HTAA is a referral hospital for the whole state of Pahang. Therefore, the sample size calculation was based on the elderly population of Pahang. The population of Pahang is estimated to be 1.5 million and the percentage of older adults is 5.1% according to the department of statistics Malaysia [15]. The formula used to calculate the required sample size is [16]

$$n' = \frac{NZ^2P(1-P)}{\left[d^2(N-1) + Z^2P(1-P)\right]},$$

where: n' is sample size with finite population correction, N is Population size, Z is Z statistic for a level of confidence, which is 1.96, P is Expected proportion of patients on PIP, and d is Precision, which is considered as 0.05.

Based on the previous studies, P was set as 0.4.

$$n' = \frac{76500 \times (1.96)^2 \times 0.4(1-0.4)}{\left[(0.05)^2 \times 76449 + (1.96)^2 \times 0.4(1-0.4)\right]} = 368.$$

The minimum required sample size to represent the hospitalized elderly population in Pahang was therefore 368 patients.

Data collection

Three trained pharmacists extracted the information from the patients' records. The pharmacists checked the ward records every morning on a daily basis. All patients who fulfilled the inclusion criteria were approached individually and were given a verbal explanation about the study together with an information sheet written in English or Malay. Demographic details of the patients, their date of admission, chief complaint, final diagnosis, comorbidities, prehospitalization medications, and their history of hospitalizations were collected. The comorbidities were scored using the age-combined Charlson comorbidity index (ACCCI) [17]. Written informed consent was obtained from all participants included in the study.

Potentially inappropriate prescribing and polypharmacy

The prehospitalization medications of the patients were reviewed twice to identify PIMs and PPOs using version 2 of the STOPP/START criteria [18]. These criteria are evidence-based recommendations that were developed from literature reviews and expert opinions and were then endorsed using Delphi consensus technique. The STOPP criteria identify PIMs that are recommended to be avoided in all older adults or in specific elderly patients where there are drug–disease or drug–drug interactions. The START criteria address the common PPOs, where there is a clear indication for a particular medication with no contraindication. Version 2 of these criteria consists of 80 STOPP criteria and 34 START criteria. Both sets of criteria are organized by the body's physiological systems under which relevant recommendations were stated in order to ease their use. In this study, polypharmacy was defined as taking five or more medications concurrently [19].

Assessment of the health-related quality of life

The EQ-5D-3L was used to assess the HRQoL of patients on admission. The EQ-5D-3L is a generic instrument that was developed by the EuroQol Group to assess the general quality of life which is not related to a specific disease [20]. The instrument consists of two parts: The first part is EQ-5D-3L which is a self-administered questionnaire that assesses the patients' health state on five dimensions (5D) namely, mobility, self-care, usual activities, pain or discomfort, and anxiety or depression at the time of administration. The response to each statement is classified into three levels (3L); 1: no problem; 2: some problem; and 3: extreme problem. The different responses to the five dimensions result in 243 possible EQ-5D health states. These combinations of health states can be converted into single index values which were derived from the Malaysian population [21]. Using these Malaysian tariffs, the EQ-5D index value ranges from 1 which represents no problems in any dimension (i.e., 11111) to 0.131 which means severe problems in the five dimensions (i.e., 33333). The second part of the instrument is a visual analog scale (EQ-VAS) that assesses the general health status. The patients were asked to rate their then-current general health status on a 100-point vertical scale with a value of zero representing the "*worst imaginable health state*" and a value of 100 indicating the *"Best imaginable health state."* The English and Malay versions of EQ-5D-3L were validated to be used among Malaysian people [22]. Written permission was obtained from the EuroQol group to use the EQ-5D-3L in this study.

Patients who did not have any PIM or PPO were considered as a reference group. The HRQoL results of patients having PIM/PPO were compared to those of the reference group to assess the association between the presence of PIM/PPO and the HRQoL.

Statistical analysis

Mean (SD) and median (IQR) were computed for the patients' characteristics and descriptive results. The data were analyzed using the Statistical Package for the Social Sciences version 24.0 (IBM SPSS Statistics 24). Shapiro–Wilk normality test was performed to test the normality of continuous variables and to subsequently select the statistical tests. One-way ANOVA test was used for parametric data. Mann–Whitney *U* test or Kruskal Wallis (≥ two groups) test was used for non-parametric data. Chi-Square test was used to compare patients who had with those who did not have PIM/PPO in regard to each of the EQ-5D dimensions. Multiple linear regression models were applied to determine the effect of exposure to PIM/PPO on the EQ-5D index/EQ-VAS, adjusting for the confounding variables. Significance was set at 5%.

Results

Patients' characteristics

Out of 517 patients who fulfilled the inclusion criteria, 502 patients (97%) accepted to be involved in the study and they completed the HRQoL questionnaire. The median (IQR) age was 71 (68–76) years. The majority of the patients were Malay (71.9%), and about half of the participants were females (48.6%). The patients were admitted to the hospital with a median (IQR) number of diseases of 3 (2–4) diseases. The most common comorbidities were hypertension, type 2 diabetes mellitus, and renal impairment. Most of the patients had an AC-CCI of more than 4. Polypharmacy was found in about two-thirds of the study population (Table 1).

Potentially inappropriate prescribing

More than half of the patients (59.2%) were admitted to the hospital with at least one PIP as identified by version 2 of the STOPP/START criteria. On the other hand, 205 patients were admitted to the hospital with no PIM or PPO (the reference group). PIMs were found in 143 patients (28.5%), and the majority of them (79%) had only one PIM. The most frequently encountered PIMs were prescribing medications that increase the risk of falls (50 patients; 10%); the use of proton pump inhibitors for more than 8 weeks in patients with uncomplicated peptic ulcer (28 patients; 5.6%); the use of metformin in patients with severe renal impairment (21 patients; 4.2%); the use of ticlopidine (16 patients; 3.2%);

Table 1 Characteristics of the study population (*n*: 502)

Variable	*N* (%)*
Sex	
Female	244 (48.6)
Male	258 (51.4)
Age	
Mean (SD) years	72.4 (5.9)
Median (range, IQR)	71 (65–93, 68–76)
Race	
Malay	361 (71.9)
Chinese	108 (21.5)
Indian	33 (6.6)
Diseases	
Mean (SD)	3 (1.2)
Median (range, IQR)	3 (1–8, 2–4)
1–2 diseases	176 (35.1)
3–4 diseases	273 (54.4)
≥ 5 diseases	53 (10.6)
Frequent comorbidities	
Hypertension	434 (86.4)
Type 2 diabetic mellitus	292 (58.17)
Chronic kidney disease	137 (27.3)
Hyperlipidemia	107(21.3)
Ischemic heart disease	79 (15.7)
COPD	74 (14.7)
AC-CCI	
2–4	281 (56)
5–7	193 (38.4)
8–10	28 (5.6)
Medications	
Total	2875
Mean (SD)	5.7 (2.5)
Median (range, IQR)	6 (1–14, 4–8)
Patients on polypharmacy (≥ 5 medications)	345 (68.7)
Potentially inappropriate prescribing	
Having at least one PIM	143 (28.5)
Having at least PPO	229 (45.6)
Having at least one PIM or PPO	297 (59.2)
History of hospitalization during the last year	
Yes	319 (63.5)
No	183 (36.5)

SD standard deviation, *IQR* interquartile range, *COPD* chronic obstructive pulmonary disease, *AC-CCI* age-combined Charlson comorbidity index, *PIM* potentially inappropriate medication, *PPO* potential prescribing omission

*Except where otherwise indicated

and the use of ß-blockers in diabetic patients with a history of frequent episodes of hypoglycemia (14 patients; 2.8%).

PPOs were found in 229 patients (45.6%) and about a third of them (32.3%) had more than one PPO. The most common PPOs were the omission of vitamin D supplements in patients with a history of falls (49 patients; 9.1%); the omission of angiotensin converting enzyme (ACE) inhibitors in diabetic patients with renal failure (45 patients; 8.3%); the omission of ACE inhibitors in patients with coronary artery disease or congestive cardiac failure (43 patients; 8%); the omission of regular inhaled $ß_2$-agonists or antimuscarinic bronchodilators in patients with mild to moderate asthma or chronic obstructive pulmonary disease (COPD) (35 patients; 6.5%); and the omission of 5α-reductase inhibitors in patients with symptomatic benign prostate hyperplasia (20 patients; 3.7%).

Health-related quality of life

The participants answered the EQ-5D-3L questions in addition to the EQ-VAS. The most commonly reported problem was related to the dimension number 4; pain or discomfort. Two hundred seventy patients (53.8%) declared that they had moderate to extreme pain. The least encountered problem of the EQ-5D dimensions was self-care, where 329 patients (65.5%) had no problem with self-care (washing and dressing) themselves. About half of the participants (46.6%) reported that they were moderately to extremely anxious or depressed.

The mean (SD) and median (IQR) EQ-5D index values were 0.734 (0.214) and 0.768 (0.630–0.879), respectively. Three patients had an EQ-5D index of 0.131 which indicates extreme problems in all five assessed dimensions. On the other hand, 109 patients (21.7%) had an EQ-5D index of 1 which means no problem in any of the dimensions. This showed that 78.3% of the patients had problems in at least one EQ-5D dimension. The mean (SD) and median (IQR) of EQ-VAS values were 59.6 (14.2) and 60 (50–70), respectively. The EQ-VAS ranged from 20 to 100.

Health-related quality of life and potentially inappropriate prescribing

No significant differences were found in the five dimensions of EQ-5D-3L between patients who had PIM or PPO and the reference group (Table 2). In addition, no significant differences were seen in the EQ-5D index between patients having PIM and the reference group (Mann Whitney U test; $P = 0.727$) or between patients having PPO and the reference group (Mann Whitney U test; $P = 0.284$). Also, the [mean (SD)] EQ-VAS of patients who had both PIM and PPO [59.6 (1.65)] was not different from that reported by the reference group [60.8 (1.07)] or patients who had only PIM [58.1 (1.67)] or PPO [58.8 (1.03)] (one-way ANOVA; $P = 0.44$).

Moreover, the number of PIMs was not significantly correlated to either the EQ-5D index ($P = 0.775$) or the EQ-VAS ($P = 0.540$). Also, the number of PPOs was not significantly

Table 2 Comparison of EQ-5D results between patients with PIP and the reference group

EQ-5D dimension	Patients (*n*: 348)		*P* value*	Patients (*n*: 434)		*P* value*
	With PIM *N* (%)	Without PIM or PPO *N* (%)		With PPO *N* (%)	Without PPO or PIM *N* (%)	
Mobility						
No problems	73 (21)	99 (28.4)	0.613	108 (24.9)	99 (22.8)	0.814
Having problems	70 (20.1)	106 (30.5)		121 (27.9)	106 (24.4)	
Self-care						
No problems	89 (25.6)	137 (39.4)	0.377	151 (34.8)	137 (31.5)	0.845
Having problems	54 (15.5)	68 (19.5)		78 (18)	68 (15.7)	
Usual activities						
No problems	78 (22.4)	124 (35.6)	0.269	131 (30.1)	124 (28.6)	0.488
Having problems	65 (18.7)	81 (23.3)		98 (22.6)	81 (18.7)	
Pain/discomfort						
No problems	59 (17)	106 (30.5)	0.055	104 (24)	106 (24.4)	0.190
Having problems	84 (24.1)	99 (28.4)		125 (28.8)	99 (22.8)	
Anxiety/depression						
No problems	75 (21.6)	193 (31.3)	0.894	128 (29.5)	109 (25.1)	0.569
Having problems	68 (19.5)	96 (27.6)		101 (23.3)	96 (22.1)	

PIP potentially inappropriate prescribing, *PIM* potentially inappropriate medication, *PPO* potential prescribing omission

*Chi-Square test

correlated to either the EQ-5D index ($P = 0.705$) or the EQ-VAS ($P = 0.359$).

To correct for possible confounding factors, multiple linear regression models were created with the EQ-5D index and EQ-VAS being the response variables of interest. Age, sex, race, comorbidity index, number of medications, having a history of hospitalization in the last year, and having PIM/PPO were entered to the regression models. Race categories were treated as dummy variables with Malay being the reference race. For sex, male was considered as the reference sex. See Table 3. All assumptions required to apply the multiple linear regression were met before running the models. The multiple regression model statistically and significantly predicted the EQ-5D index; $F(9, 492) = 0.045$, $P = 0.017$, adj. $R^2 = 0.022$. However, the presence of PIM or PPO did not significantly affect the EQ-5D index and only age and

Table 3 Variables included in the EQ-5D index and EQ-VAS regression models

Variable	EQ-5D index regression model		EQ-VAS regression model	
	Unstandardized coefficients (B)	Standard error	Unstandardized coefficients (B)	Standard error
Constant	1.018	0.126	76.426	8.356
Age	−0.003*	0.002	−0.138	0.115
Female sex	−0.047*	0.019	0.206	1.275
Race (Chinese)	0.035	0.024	1.571	1.568
Race (Indian)	0.066	0.40	0.349	2.630
AC-CCI	−0.008	0.007	−1.002*	0.450
Number of prehospitalization medications	0.005	0.004	−0.235	0.289
Having a history of hospitalization during the last 12 months	−0.021	0.020	−1.976	1.336
Having PIM	−0.004	0.022	−0.362	1.435
Having PPO	−0.005	0.020	0.108	1.327

AC-CCI age-combined Charlson comorbidity index, *PIM* potentially inappropriate prescribing, *PPO* potential prescribing omission, *CI* confidence interval

*Significant: *P* value < 0.05

sex added statistically and significantly to the prediction, $P < 0.05$. See Table 3.

The other multiple regression model also statistically and significantly predicted the EQ-VAS; $F(9, 492) = 195$, $P = 0.040$, adj. $R^2 = 0.016$. Likewise, the presence of PIM or PPO did not affect the EQ-VAS and only the comorbidity index (AC-CCI) added statistically and significantly to the prediction ($P = 0.030$). See Table 3.

Discussion

The current study investigated the association between the presence of PIP and the HRQoL as measured by the EQ-5D-3L. EQ-5D is a widely used tool to assess HRQoL in elderly patients including those with cognitive impairment [23]. Besides, EQ-5D is an easy-to-use tool and was found to be a significant predictor of mortality and hospitalization [24]. The mean (SD) values of HRQoL (EQ-5D index and EQ-VAS) of this study population were lower than those reported from the general Malaysian population [22], which reflects the impact of aging on the HRQoL.

The most common diseases in the study sample were hypertension, diabetes mellitus, and renal impairment. More than half of the participants reported having pain or discomfort and that was the most common complaint. This finding is similar to what was reported by other studies from hospital settings [25–27]. It may be anticipated that hospitalized patients suffer from various degrees of pain as most of the acute illnesses present with pain. Identical to other studies, self-care was the least frequently encountered problem among the current study population [25, 26, 28]. It is noteworthy to mention that about half of the patients (46.6%) complained of moderate to extreme anxiety or depression. This percentage is much higher than that found in community-dwelling or nursing home elderlies [12, 25, 27]. However, this result is analogous to that found in discharged patients [1], which may indicate the influence of hospital admission on patients' mood.

The study showed that more than half of the admitted patients had at least one PIP. Nonetheless, no association was found between the presence of PIM or PPO and the HRQoL. Moreover, increasing the number of PIMs or PPOs did not significantly affect the HRQoL. After controlling for the confounding variables, the multiple linear regression showed that the presence of PIM or PPO was not a significant predictor of HRQoL. These results are consistent with those reported from the only available study in Malaysia that addressed this issue in older people at nursing homes [12]. The prevalence of PIM in our study was comparable to the prevalence reported in that study (23.7%) using the same criteria (STOPP criteria), and the mean values of EQ-5D index and EQ-VAS were identical as well. In addition, the authors of that study disclosed no significant differences in HRQoL values between elderlies who were on PIM and others who were not. Similar findings were also seen from the Irish Longitudinal Study on Ageing (TILDA), in which the presence of STOPP PIM or START PPO was not correlated to the patients' quality of life measured by CASP-R12 [11]. In contrast, several other studies found a significant association between the use of PIM and a lower HRQoL [1, 3, 9, 29]. Differences in the study design and setting, as well as differences in the healthcare system and prescribing patterns between Malaysia and other countries, may account for the shown discrepancies between the results of the current study and other studies. For instance, in the study done by Wallace et al., the age of the study population (≥ 70 years) and the STOPP PIMs prevalence (40%) were higher than those of our study. The authors found that inappropriate medication significantly reduced the EQ-5D index only in the group of patients having ≥ 2 STOPP PIMs [9]. Also, the study conducted by Olsson et al. calculated the medication appropriateness index (MAI) of the patients' discharge medications and its relationship with the patients' quality of life. The researchers divided their study population into three groups based on the MAI score and found significant differences between the groups in terms of the EQ-5D index. Nevertheless, when the results were adjusted to age, sex, and number of medications, only the difference between the lowest MAI (best medication quality) group and the highest MAI (worst medication quality) group remained significant [1]. Fu et al. declared that patients taking PIMs had a significantly poorer quality of life than patients who were not on PIMs, even after controlling for other variables [29]. The investigators used one five-point item to evaluate the general health status of participants which may have attributed to the results of the study. The other study on 1161 from non-institutionalized older people in the United States revealed that taking PIM was significantly associated with the EQ-5D index but not the EQ-VAS. However, when PIM was entered with other co-variables into multiple regression models, PIM was not found to be a significant predictor neither for the EQ-5D index nor for the EQ-VAS [3]. Regarding drug underuse (i.e., the presence of PPO), a study from Germany found a significant association between PPO and HRQoL. However, it was not a cross-sectional but a longitudinal study where the increase in the number of inappropriately omitted medications, between the two follow-ups, reduced the EQ-VAS by 1.29 point compared with the baseline values [10].

The multiple linear regression models showed that advancing age, female sex, and a high comorbidity index were significantly associated with the HRQoL. It is a well-known fact that advancing age results in a reduced quality of life as it is associated with functional decline and a various number of studies demonstrated the negative impact of advancing age on HRQoL [25, 27]. Female sex was

previously reported to be associated with more problems in the EQ-5D dimensions [27] and a lower EQ-5D index [25]. Charlson Comorbidity Index was originally developed as a prognostic tool for comorbidities that increase the risk for short-term mortality. Accordingly, it may be deduced that having a high CCI would impair the patient's HRQoL.

Limitations

The study was conducted in one hospital only and because of the inclusion criteria, the results could not be generalized to the entire community-dwelling hospitalized elderly patients in Malaysia. Besides, the sample was not randomly selected. In addition, the study used the EQ-5D-3L only to measure the patients' HRQoL. Even though the EQ-5D-3L is one of the most recognized instruments for this purpose, it has some limitations as well. It measures the HRQoL on the day of administration only, which may not reflect the patient's HRQoL during the whole period of being on PIP. Also, the measured aspects are limited to the five essential dimensions with only three levels of responses which makes the instrument subjected to the ceiling effect. Therefore, the EQ-5D-3L may not be sensitive enough to catch small differences between patients. Furthermore, the linear regression may not be the ideal technique to investigate the predictors of HRQoL as it does not take into consideration the right-censoring in the dependent variable (more 20% of the patients had a full health state). Finally, this study is limited by its designs as a cross-sectional study. A larger multi-center prospective study may be considered necessary in Malaysia to further investigate this issue.

Conclusion

This study investigated the HRQoL of elderly patients admitted to the multidisciplinary medical and surgical wards in a tertiary hospital in Malaysia. Pain or discomfort was the most common complaint followed by anxiety or depression. Age, sex, and comorbidity index were significantly associated with HRQoL. Older female patients with high comorbidity index are expected to have a lower HRQoL—as measured by the EQ-5D-3L—compared to other Malaysian populations. Potentially inappropriate prescribing was quite common but it did not significantly affect the HRQoL regardless of the number of PIMs/PPOs found. However, this must not be taken as proof of safety of using PIP, as PIP is well known to be associated with several negative health-related outcomes.

Funding This study was funded by the International Islamic University Malaysia (IIUM) Research Initiative Grant Scheme (No. RIGS 15- 098-0098).

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval The study was conducted in accordance with the guidelines of the 1964 Helsinki declaration and its later amendments. Ethical approval was obtained from the Medical Research and Ethics Committee, Ministry of Health Malaysia (No. NMRR-15-718-25235), and from the Clinical Research Center (CRC) of the HTAA hospital.

References

1. Nordin Olsson, I., Runnamo, R., & Engfeldt, P. (2011). Medication quality and quality of life in the elderly, a cohort study. *Health and Quality of Life Outcomes, 9*(1), 95. https://doi.org/10.1186/1477-7525-9-95.
2. Karimi, M., & Brazier, J. (2016). Health, Health-related quality of life, and quality of life: What is the difference? *PharmacoEconomics, 34*(7), 645–649. https://doi.org/10.1007/s40273-016-0389-9.
3. Franic, D. M., & Jiang, J. Z. (2006). Potentially inappropriate drug use and health-related quality of life in the elderly. *Pharmacotherapy, 26*(6), 768–778. https://doi.org/10.1592/phco.26.6.768.
4. Kaplan, R. M. (2003). The significance of quality of life in health care. In *Quality of life research* (Vol. 12, pp. 3–16). Dordrecht: Kluwer Academic Publishers. https://doi.org/10.1023/A:1023547632545.
5. Rolfes, L., van Hunsel, F., Taxis, K., & van Puijenbroek, E. (2016). The Impact of experiencing adverse drug reactions on the patient's quality of life: A retrospective cross-sectional study in the Netherlands. *Drug Safety, 39*(8), 769–776. https://doi.org/10.1007/s40264-016-0422-0.
6. O'Connor, M. N., Gallagher, P., & O'Mahony, D. (2012). Inappropriate prescribing: Criteria, detection and prevention. *Drugs & Aging, 29*(6), 437–452. https://doi.org/10.2165/11632610-000000000-00000.
7. Hamilton, H., Gallagher, P., Ryan, C., Byrne, S., & O'Mahony, D. (2011). Potentially inappropriate medications defined by STOPP criteria and the risk of adverse drug events in older hospitalized patients. *Archives of Internal Medicine, 171*(11), 1013–1019. https://doi.org/10.1001/archinternmed.2011.215.
8. van der Stelt, C. A. K., Windsant-van den Tweel, A. M. A., Egberts, A. C. G., Van den Bemt, P. M. L. A., Leendertse, A. J., Hermens, W. A. J. J., Derijks, H. J. (2016). The association between potentially inappropriate prescribing and medication-related hospital admissions in older patients: A nested case control study. *Drug Safety, 39*(1), 79–87. https://doi.org/10.1007/s40264-015-0361-1.
9. Wallace, E., McDowell, R., Bennett, K., Fahey, T., & Smith, S. M. (2017). Impact of potentially inappropriate prescribing on adverse drug events, health related quality of life and emergency hospital attendance in older people attending general practice: A prospective cohort study. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences, 72*(2), 271–277. https://doi.org/10.1093/gerona/glw140.
10. Meid, A. D., Quinzler, R., Groll, A., Wild, B., Saum, K. U., Schöttker, B., Haefeli, W. E. (2016). Longitudinal evaluation of medication underuse in older outpatients and its association

with quality of life. *European Journal of Clinical Pharmacology, 72*(7), 877–885. https://doi.org/10.1007/s00228-016-2047-8.
11. Moriarty, F., Bennett, K., Cahir, C., Kenny, R. A., & Fahey, T. (2016). Potentially inappropriate prescribing according to STOPP and START and adverse outcomes in community-dwelling older people: a prospective cohort study. *British Journal of Clinical Pharmacology, 82*, 849–857. https://doi.org/10.1111/bcp.12995.
12. Al Aqqad, S. M. H., Chen, L. L., Shafie, A. A., Hassali, M. A., & Tangiisuran, B. (2014). The use of potentially inappropriate medications and changes in quality of life among older nursing home residents. *Clinical Interventions in Aging, 9*, 201–207. https://doi.org/10.2147/CIA.S52356.
13. Lim, L. M., McStea, M., Chung, W. W., Azmi, N. N., Aziz, S. A. A., Alwi, S., Rajasuriar, R. (2017). Prevalence, risk factors and health outcomes associated with polypharmacy among urban community-dwelling older adults in multiethnic Malaysia. *PLoS ONE, 12*(3), 1–18. https://doi.org/10.1371/journal.pone.0173466.
14. Najjar, M. F., AbdulRazzaq, H. A., Altaie, A. H., Kassab, Y. W., Hassan, Y., & Abd Aziz, N., (2013). Assessment of potentially inappropriate medications and risk of drug-drug interactions among geriatric inpatients in Penang Hospital. *International Journal of Clinical Pharmacy (Vol, 35*, 911–912.
15. *Population distribution and basic demographic characteristic report*. (2011). Retrieved from https://www.dosm.gov.my/v1/index.php?r=column/ctheme&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhUUT09&bul_id=MDMxdHZjWTk1SjFzTzNkRXYzcVZjdz09.
16. Naing, L., Winn, T., & Rusli, B. N. (2006). Practical issues in calculating the sample size for prevalence studies. *Archives of Orofacial Sciences, 1*, 9–14. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.504.2129&rep=rep1&type=pdf.
17. Charlson, M., Szatrowski, T. P., Peterson, J., & Gold, J. (1994). Validation of a combined comorbidity index. *Journal of Clinical Epidemiology, 47*(11), 1245–1251. https://doi.org/10.1016/0895-4356(94)90129-5.
18. O'Mahony, D., O'Sullivan, D., Byrne, S., O'Connor, M. N., Ryan, C., & Gallagher, P. (2015). STOPP/START criteria for potentially inappropriate prescribing in older people: Version 2. *Age and Ageing, 44*(2), 213–218. https://doi.org/10.1093/ageing/afu145.
19. Gnjidic, D., Hilmer, S. N., Blyth, F. M., Naganathan, V., Waite, L., Seibel, M. J., Le Couteur, D. G. (2012). Polypharmacy cut-off and outcomes: Five or more medicines were used to identify community-dwelling older men at risk of different adverse outcomes. *Journal of Clinical Epidemiology, 65*(9), 989–995. https://doi.org/10.1016/j.jclinepi.2012.02.018.
20. Rabin, R., & Charro, F., & De (2001). EQ-SD: A measure of health status from the EuroQol Group. *Annals of Medicine, 33*(5), 337–343. https://doi.org/10.3109/07853890109002087.
21. Md Yusof, F. A., Goh, A., & Azmi, S. (2012). Estimating an EQ-5D value set for malaysia using time trade-off and visual analogue scale methods. *Value in Health, 15*(1 SUPPL.), S85–S90. https://doi.org/10.1016/j.jval.2011.11.024.
22. Shafie, A. A., Hassali, M. A., & Liau, S. Y. (2011). A cross-sectional validation study of EQ-5D among the Malaysian adult population. *Quality of Life Research, 20*(4), 593–600. https://doi.org/10.1007/s11136-010-9774-6.
23. Wolfs, C. A. G., Dirksen, C. D., Kessels, A., Willems, D. C. M., Verhey, F. R. J., & Severens, J. L. (2007). Performance of the EQ-5D and the EQ-5D+C in elderly patients with cognitive impairments. *Health and Quality of Life Outcomes*, 5(33). https://doi.org/10.1186/1477-7525-5-33.
24. Cavrini, G., Broccoli, S., Puccini, A., & Zoli, M. (2012). EQ-5D as a predictor of mortality and hospitalization in elderly people. *Quality of Life Research, 21*(2), 269–280. https://doi.org/10.1007/s11136-011-9937-0.
25. Mangen, M. J. J., Bolkenbaas, M., Huijts, S. M., van Werkhoven, C. H., Bonten, M. J. M., & de Wit, G. A. (2017). Quality of life in community-dwelling Dutch elderly measured by EQ-5D-3L. *Health and Quality of Life Outcomes, 15*(1), 3. https://doi.org/10.1186/s12955-016-0577-5.
26. Clemens, S., Begum, N., Harper, C., Whitty, J. A., & Scuffham, P. A. (2014). A comparison of EQ-5D-3L population norms in Queensland, Australia, estimated using utility value sets from Australia, the UK and USA. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation, 23*(8), 2375–2381. https://doi.org/10.1007/s11136-014-0676-x.
27. König, H. H., Heider, D., Lehnert, T., Riedel-Heller, S. G., Angermeyer, M. C., Matschinger, H., Alonso, J. (2010). Health status of the advanced elderly in six european countries: Results from a representative survey using EQ-5D and SF-12. *Health and Quality of Life Outcomes, 8*(1), 143. https://doi.org/10.1186/1477-7525-8-143.
28. Perneger, T. V., Combescure, C., & Courvoisier, D. S. (2010). General population reference values for the french version of the euroqol EQ-5D health utility instrument. *Value in Health, 13*(5), 631–635. https://doi.org/10.1111/j.1524-4733.2010.00727.x.
29. Fu, A. Z., Liu, G. G., & Christensen, D. B. (2004). Inappropriate medication use and health outcomes in the elderly. *Journal of the American Geriatrics Society, 52*(11), 1934–1939. https://doi.org/10.1111/j.1532-5415.2004.52522.x.