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RESEARCH ARTICLE

Drug-related problems associated with community-dwelling older persons living alone in Singapore

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Abstract

Background Older persons living alone have been associated with poorer health outcomes and higher mortality rate. However, little is known about the drug related problems (DRPs) faced by this population group in Singapore. *Objectives* This study aims to elucidate the prevalence and type of DRPs associated with older persons living alone. *Setting* Eleven Senior Activity Centers in Singapore. *Method* Individuals aged above 55 years, taking at least one oral chronic medication and living in the housing estate served by the Senior Activity Centers were recruited to participate in an individual interviewer-administered cross-sectional survey. Those who were unable to comprehend the survey or communicate their responses fully were excluded. DRPs were identified by the interviewers and reported using a modified DOCUMENT system. *Main outcome measure* The main outcome measure was the difference in prevalence and types of DRPs between survey participants with different living arrangements. *Results* Among 360 respondents, 152 (42.2%) were older persons living alone. A higher prevalence (61.2% vs. 47.6%, adjusted OR = 1.86 [1.12–3.10], $p = 0.016$) and mean number of DRPs (1.23 ± 1.4 vs. 0.95 ± 1.33, $p = 0.018$) were observed among older persons living alone in comparison with those who were not living alone. Specifically, those living alone were more likely to have DRP related to the category 'Taking too little' (adjusted OR = 2.32 [1.28–4.20], $p = 0.006$) and which involved the use of HMG-CoA reductase inhibitors (adjusted OR = 2.78 [1.16–6.69], $p = 0.022$). *Conclusion* Besides having a significantly higher prevalence of DRP, older persons living alone were more likely to be non-adherent to their medications, particularly statins. Targeted interventions to reduce these DRPs and ensure appropriate management of chronic conditions should be derived, especially for those who lack the ability to help themselves.

Keywords Community-dwelling · Drug-related problems · Elderly · Geriatrics · Living alone · Medication adherence · Singapore

Impacts on practice

- As older persons living alone are less likely to have the support of caregivers to assist with their medication management and adherence at home, collaborative community based interventions between healthcare professionals and social care services can be helpful to ensure and monitor for the effective and safe use of medicines by this population.
- Although older persons living alone are more likely to be non-adherent in general, this may be related to their beliefs about specific medications such as statins. Thus, interventions for improving non-adherence should incorporate strategies that address the reasons for non-adherence, correct misconceptions and enhance adequate understanding of the prescribed medications.

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Introduction

Drug related problems (DRPs) are events involving drug treatment that actually or potentially interferes with the optimal outcome of medical care [1] and can be associated with

suboptimal therapy, decreased quality of life, increased hospital admission and healthcare costs [2]. Globally, DRPs has been estimated to contribute 5–10% of hospital admissions, in which 50% are avoidable [3]. The cost of DRP-induced morbidity and mortality is also substantial, with a yearly estimate of US$177.4 billion in the United States [4]. DRPs are of concern especially for older persons due to the higher incidence of chronic diseases which translate to an increase in medication usage [5]. In addition, age-related physiological changes result in alteration of pharmacokinetics and pharmacodynamics, making them more vulnerable to the drug's adverse effect [5]. Reported risk factors for DRPs include declining cognitive status, polypharmacy, medication-related knowledge, use of medication with narrow therapeutic window and non-adherence [6]. Of interest, a number of research studies also showed that living alone may be associated with DRPs such as therapeutic duplication and non-compliance [7, 8].

In Singapore, there is an increasing proportion of older persons living alone (OPLA) from 3% in 1995 to 15% in 2011 [9]. Reasons for living alone may include being childless, outliving their family members, abandonment by their children or by choice [10]. OPLA are considered a vulnerable group due to the difficult living situations, limited resources and lack of support [11]. Furthermore, OPLA are usually associated with poorer health outcomes and higher mortality rate compared to those living with others [11, 12]. Although psychosocial well-being and health-related problems have been reported among OPLA in Singapore [13], little is known about the DRPs faced by this group of older persons. Having such data can be useful for government agencies and various institutions in devising more focused plan to better address the pharmaceutical needs of OPLA.

Aim of the study

This study aims to elucidate the prevalence and types of DRPs among community-dwelling older persons served by the Senior Activity Centers (SACs) in Singapore, with a comparison of that found among OPLA against those living with others.

Ethics approval

Ethics approval was obtained by the National University of Singapore Institutional Review Board (Approval Certificate: NUS 2039).

Method

Study design and sites

This study was a cross-sectional survey conducted at 11 SACs across Singapore from November 2012 to December 2015. These SACs are operated by various non-profit volunteer-welfare organizations to provide socio-recreational programs and support services for the needy older persons living in the one- and two-room rental housing in the vicinity of which the SACs are located [14].

Sample size calculation and study population

Participants were recruited if they were aged above 55 years, taking at least one chronic medication, registered under one of the 11 participating SACs and 4) able to communicate in English, Mandarin, Teochew or Hokkien. Participants who could only converse in other languages were included only if a translator was available at the SAC and trained for the purpose of conducting this survey. Participants who were unable to comprehend the survey questions or communicate their responses fully were excluded from this study. Based on the total of 28,995 older persons served by SACs in 2014 [15], a sample size of at least 269 was needed to achieve 90% confidence level with a 5% margin of error and a conservative assumption of 50% response distribution [16]. Hence, a recruitment of 360 participants was targeted for this study.

Participant recruitment and data collection

Based on the inclusion and exclusion criteria, eligible participants were first shortlisted and contacted by the administrators in-charge of each participating SAC. Interested participants were then scheduled for a face-to-face individual interview with a pair of trained interviewers (final year pharmacy undergraduate students). All participants were informed to bring their medications and any available medical reports to ensure accuracy and objectivity of the data collected during the interview. Informed consent were also obtained prior to starting the interviews.

All interviews were conducted in the private rooms within the respective SACs in the participants' most preferred language. Interviews for participants who are homebound due to immobility were conducted in the participants' own home. Standardized English and Mandarin versions of the survey questionnaire were developed for the collection of sociodemographic information, medical- and medication-related information. Where pre-validated survey questions in Mandarin was not available, translation of the English survey questions to Mandarin was validated using forward and backward translations. Verbal translations to Mandarin dialects (Teochew and Hokkien) were based on the Mandarin version of the questionnaire. Each interview lasted about 45–60 min and was carried out using the think-aloud techniques [17]. Upon completion of the interview, each participant received a $15 voucher as a token of appreciation.

Sociodemographic information

Demographics collected include age, gender, ethnicity, marital status, highest education level obtained, health literacy, housing type, home ownership, and mobility. Participants were asked whether they were currently living alone or with others (spouse, children, relatives or non-relatives) and if they had a caregiver who managed their medications. Living alone was defined as a one-person household [18]. Self-reported health literacy was assessed using a validated 3-question health literacy tool, where a score of 9 and above indicates adequate health literacy [19].

Medical- and medication-related information

Participants were asked to report their current medical conditions as well as the number of chronic and as-needed medications they were prescribed with. Information with regards to the medication name, strength, dosage form and dosing frequency were noted down directly from the dispensing labels. Medications were classified and reported according to the anatomical therapeutic chemical (ATC) coding system [20]. Participants were then asked to describe how they were taking their medications and whether they experienced any problems and unpleasant effects from their medications.

Assessment and classification of drug-related problems

DRPs were identified by the interviewers from the data that were self-reported and/or obtained from physical medications and dispensing labels as described above. Lexicomp® was used as the standard reference to assess DRPs [21]. The identified DRPs were classified and reported based on the DOCUMENT classification system, which has been validated and implemented in all Australian community pharmacies [22], and had a systematic flowchart to aid the DRP classification by the interviewers. For this study, only DRPs that can be objectively identified based on the available data were reported. Based on the DOCUMENT DRP classification flowchart, DRPs that cannot be placed under any other category were considered as 'Non-classifiable'. Only potential drug–drug interactions with a risk rating of 'X' in Lexi-Interact online database were reported; such DRPs involving more than one drug classes were counted only once for the estimation of the total number and prevalence of DRPs among the participants.

Outcome measures

Prevalence of drug-related problems

The prevalence of DRPs was defined as the percentage of total participants with one or more DRPs. The mean number of DRPs and the individual prevalence of each DRP category classified based on DOCUMENT classification system were reported. These outcomes were then compared between OPLA and older persons living with others.

Prevalence of drug-related problems by drug classes

The prevalence of DRPs by drug classes were also reported and compared among OPLA and older persons living with others. DRPs involving more than one drug class (drug–drug interactions) were counted once for each of the involved drug classes for this analysis.

Data analysis

The statistical software Statistical Package for Social Science (SPSS) version 23 was used for data analysis. Descriptive statistics was used to report participant sociodemographic and medical-related variables studied. Means with standard deviations and numbers with percentages were used to report continuous and categorical variables respectively. Differences in baseline information and prevalence of DRP by categories and drug classes between OPLA and those living with others were evaluated using Student's *t* test or Mann–Whitney U test and Pearson's Chi square test or Fisher's exact test where appropriate for continuous and categorical outcome variables respectively. Shapiro–Wilk test was used to test for normality of continuous data. Sociodemographic and medical-related variables found to be statistically different between OPLA and those living with others were included in the logistic regression for adjusting their effects on the association between participants' living arrangement and the prevalence of DRPs. Multicollinearity among the factors was assessed with correlation matrix, tolerance and variance inflation factor statistics. All statistical tests were two-sided and results were considered statistically significant when $p < 0.05$.

Results

Participant sociodemographic and medical-related information

A total of 360 participants were surveyed in the study, providing a response rate of 96.8% (Fig. 1). Their sociodemographic and medical-related profile are summarized in Table 1. The mean age of the participants was 74.4 ± 7.6 years old. The majority were female (70.8%) and Chinese (79.2%) yet, only 40.3% indicated a preference to use English and/or Mandarin as their main language. In all, 152 (42.2%) participants reported living alone. Among those living with others, 150 (72.1%) of them live either with

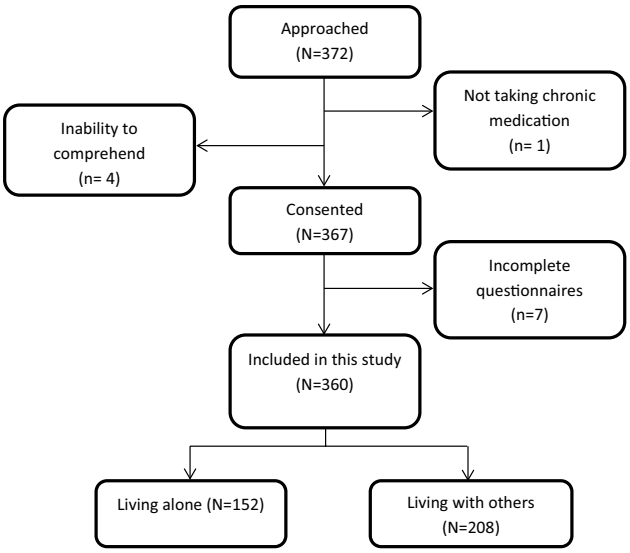

Fig. 1 Graphical representation of the study recruitment of 360 participants

their spouse, children or both, 27 (13.0%) participants live with their relative(s) and 31 (14.9%) participants live with non-relative(s). Statistically significant differences among baseline characteristics included presence of caregiver, marital status, housing type, and diabetes. OPLA were more likely to be single, divorced or widowed (92.1% vs. 52.9%, $p<0.001$), less likely to have a caregiver (4.6% vs. 38.0%, $p<0.001$), and live in one or two-room flats (96.1% vs. 85.6%, $p=0.001$). Older persons who were living with others were more likely to be diagnosed with diabetes (39.4% vs. 28.9%, $p=0.040$), prescribed with biguanides (29.8% vs. 19.7%, $p=0.030$) and sulfonylureas (24.0% vs. 14.5%, $p=0.025$).

Drug-related problems

In total, 384 DRPs were identified among 192 (53.3%) participants who had one or more DRP. The mean (±SD) number of DRPs identified per participant was 1.07 (±1.37) and ranged from 0 to 6. The top three DRP categories involved were 'Compliance' (239 DRPs, 62.2%), 'Education' (47 DRPs, 12.2%) and 'Drug selection' (39 DRPs, 10.2%).

Comparison of drug-related problems identified among OPLA against those living with others

OPLA had a higher prevalence and mean number of DRPs (61.2% vs. 47.6%, $p=0.011$; 1.23 ± 1.41 vs. 0.95 ± 1.33, $p=0.018$) After adjusting for the significant baseline sociodemographic and medical-related factors, OPLA are 1.9 times more likely to have DRP compared to those living with others (adjusted OR = 1.86, [95% CI 1.12–3.10], $p=0.016$).

The comparisons in prevalence of DRPs by categories and drug classes between OPLA and those living with others are summarised in Table 2. Significantly, OPLA were more likely to have DRP subcategory 'Taking too little' (33.6% vs. 18.8%, $p=0.001$; adjusted OR = 2.32 [95% CI 1.28–4.20], $p=0.006$) compared to older persons living with others.

Prevalence of drug-related problems by drug classes

A total of 396 drugs were associated with 374 (97.4%) DRPs. The other 10 (2.6%) DRPs were related to disease management advice or unknown drugs that could not be verified by objective data. Statins was involved in the most number of DRPs (41, 10.7% of all DRPs identified), with simvastatin being the most commonly implicated drug (29, 70.7% of all statins involved in DRPs). The prevalence of DRPs involving statin was significantly higher among OPLA (15.1% vs. 7.7%, $p=0.025$; adjusted OR = 2.78 [95% CI 1.16–6.69], $p=0.022$). The three most commonly identified DRP among statins were 'Compliance' (24, 58.5%), followed by 'Over or under dose' (7, 17.1%) and 'Toxicity or adverse effect present' (5, 12.2%). OPLA were also more likely to have statin-related DRP category of 'Compliance' (9.9% vs. 4.3%, $p=0.037$; adjusted OR = 3.197 [95% CI 1.04 to 9.79], $p=0.042$).

Discussion

This is the first study in Singapore that directly compared the prevalence and types of DRPs among OPLA in neighbourhood communities (61.2%) against that among those who are not living alone (47.6%). In this study, about one in every two older persons attending SAC had at least one DRP. Although the mean number of DRPs identified from our study cohort (1.07 ± 1.37) is similar to an Australian study (which reported 1.3 ± 1.22 DRP per participant) [23], studies in other countries have reported up to 10 DRPs per home-dwelling older persons [24]. A possible reason for the lower prevalence of DRP in this study could be the lower number of chronic diseases and medication usage among the participants, which were commonly reported as factors correlated to the number of DRPs [25].

In order to obtain a representative sample of seniors attending SACs, 55 years of age was used as the lower age limit for participation in this study to reflect SAC's service criteria. Despite including participants as young as 55 years, the mean ages between OPLA and older persons not living alone were comparable (Table 1). Hence the comparison of DRPs between OPLA and those not living alone was not likely to be affected by variations in age between the two groups.

Table 1 Comparison of participant sociodemographic and medical-related profile between older persons living alone versus those living with others

Variables	Total (N = 360)	Living alone (N = 152)	Living with others (N = 208)	*p* value
	n (%)	n (%)	n (%)	
Age in years [mean (± SD)]	74.4 (± 7.6)	75.1 (7.2)	74.0 (7.9)	0.174[a]
Gender				
Male	105 (29.2)	40 (26.3)	65 (31.3)	0.309[b]
Race				
Chinese	285 (79.2)	125 (82.2)	160 (76.9)	0.220[b]
Marital status				
Married	110 (30.6)	12 (7.9)	98 (47.1)	**< 0.001**[b]
Single, divorced or widowed	250 (69.4)	140 (92.1)	110 (52.9)	
Education				
Did not attend school	229 (63.6)	97 (63.8)	132 (63.5)	0.511[b]
Primary school	86 (23.9)	33 (21.7)	53 (25.5)	
Secondary school and above	45 (12.5)	22 (14.5)	23 (11.1)	
Preferred language				
English and/or Mandarin	145 (40.3)	67 (44.1)	78 (37.5)	0.209[b]
Health literacy				
Adequate	128 (35.6)	59 (38.8)	69 (33.2)	0.269[b]
Caregiver				
Present	86 (23.9)	7 (4.6)	79 (38.0)	**< 0.001**[b]
Housing type				
One- or two-room flat	324 (90.0)	146 (96.1)	178 (85.6)	**0.001**[b]
Home ownership				
Rented	288 (80.0)	127 (83.6)	161 (77.4)	0.150[b]
SAC Site (Location)				
SAC 1 (South)	60 (16.7)	26 (17.1)	34 (16.3)	0.645[b]
SAC 2 (North West)	45 (12.5)	20 (13.2)	25 (12.0)	
SAC 3 (Central)	38 (10.6)	15 (9.9)	23 (11.1)	
SAC 4 (Central North)	35 (9.7)	13 (8.6)	22 (10.6)	
SAC 5 (East)	34 (9.4)	19 (12.5)	15 (7.2)	
SAC 6 (North West)	33 (9.2)	11 (7.2)	22 (10.6)	
SAC 7 (Central)	32 (8.9)	17 (11.2)	15 (7.2)	
SAC 8 (Central East)	23 (6.4)	9 (5.9)	14 (6.7)	
SAC 9 (South East)	22 (6.1)	10 (6.6)	12 (5.8)	
SAC 10 (South)	20 (5.6)	6 (3.9)	14 (6.7)	
SAC 11 (Central North)	18 (5.0)	6 (3.9)	12 (5.8)	
Mobility				
Dependent or immobile	22 (6.1)	6 (3.9)	16 (7.7)	0.143[b]
Number of chronic diseases [mean (± SD)]	3.2 (1.3)	3.1 (1.3)	3.3 (1.3)	0.260[c]
Top 5 chronic diseases				
Hypertension	312 (86.7)	133 (87.5)	179 (86.1)	0.691[b]
Dyslipidemia	270 (75.0)	113 (74.3)	157 (75.5)	0.805[b]
Bone problem	151 (41.9)	64 (42.1)	87 (41.8)	0.958[b]
Diabetes	126 (35.0)	44 (28.9)	82 (39.4)	**0.040**[b]
Heart problem	72 (20.0)	32 (21.1)	40 (19.2)	0.670[b]
Number of medication [mean (± SD)]	6.0 (3.1)	6.1 (3.1)	6.0 (3.1)	0.719[c]
Number of chronic medication only [mean (± SD)]	5.3 (2.6)	5.3 (2.6)	5.3 (2.6)	0.935[c]
Number of 'as-needed' medication only [mean (± SD)]	0.7 (1.3)	0.8 (1.4)	0.6 (1.3)	0.226[§]
Polypharmacy (use of > 4 chronic medication)	201 (55.8)	86 (56.5)	115 (55.3)	0.808[b]

Table 1 (continued)

Variables	Total (N = 360)	Living alone (N = 152)	Living with others (N = 208)	*p* value
	n (%)	n (%)	n (%)	
Top 10 prescribed drug groups (ATC level 4)[d]				
[C10AA] Statins	263 (73.1)	108 (71.1)	155 (74.5)	0.464[b]
[C08CA] Dihydropyridine calcium channel blocker	181 (50.3)	78 (51.3)	103 (49.5)	0.736[b]
[A12AA] Calcium	130 (36.1)	57 (37.5)	73 (35.1)	0.639[b]
[C07AB] Selective beta blockers	125 (34.7)	51 (33.6)	74 (35.6)	0.690[b]
[C09AA] ACE inhibitors	100 (27.8)	46 (30.3)	54 (26.0)	0.368[b]
[B01AC] Anti-platelets	93 (25.8)	35 (23.0)	58 (27.9)	0.298[b]
[A10BA] Biguanides	92 (25.6)	30 (19.7)	62 (29.8)	**0.030**[b]
[A02BC] Proton pump inhibitors	84 (23.3)	37 (24.3)	47 (22.6)	0.699[b]
[C09CA] Angiotensin II antagonists	75 (20.8)	27 (17.8)	48 (23.1)	0.220[b]
[A10BB] Sulfonylureas	72 (20.0)	22 (14.5)	50 (24.0)	**0.025**[b]

[a]Independent *t* test; statistically significant *p* values in bold

[b]Chi square test; statistically significant *p* values in bold

[c]Mann–Whitney *U* test; statistically significant *p* values in bold

[d]Drug classified according to anatomical therapeutic chemical (ATC) coding system

Due to the quantitative nature of the data collected in this cross-sectional survey study, we cannot be certain why diabetes was more prevalent among older persons who were not living alone (39.4% vs. 28.9%; $p = 0.040$), and additional analysis did not identify any association between the presence of diabetes with presence of caregivers (Chi square test, $p = 0.112$). There was also no data collected to determine if one group of participants was more dependent and therefore require the presence of caregivers. However, since all recruited participants were active members at Senior Activity Centers, they were all ambulatory and deemed to have similar levels of independence. Regardless of the reasons for the presence or absence of a caregiver, it is not surprising to find OPLA being 2.3 times more likely to have DRPs related to the Compliance category of 'Taking too little' ($p = 0.006$) given the significant absence of caregivers for OPLA in this study, who could otherwise monitor and provide reminders for these older persons to take their medications [8]. This finding is corroborated by another study which reported OPLA having a higher propensity to be less adherent to their medications [26]. As such, OPLA were taking less of or not taking their medications, which may lead to possible consequences of inadequate chronic disease management and subsequent associated complications such as poor health outcome, unplanned hospitalization and increased economic burden. Hence, OPLA may benefit from targeted interventions such as education and reminder aids for improving medication adherence. While healthcare professionals can provide counseling on the importance of medication therapy and the consequences of non-adherence, the established social and communication channels from SAC can contribute regular support in terms of face-to-face or telephone reminders to improve medication compliance among OPLA. The latter is important as OPLA would also have no one else at home to provide immediate assistance in the event of medical emergencies [11].

Overall, statins was involved in the most number of DRPs identified in this study (41 DRPs among 39 participants), where the majority was related to 'Compliance' (24, 58.5%) problems. Although non-adherence to lipid modifying agents, particularly statins, has been frequently reported [27, 28], this was found to be more apparent among OPLA in this study in comparison to those living with others ($p = 0.042$). As elevated cholesterol is usually asymptomatic, some may believe that they do not need this medication to prevent future risk of developing cardiovascular disease [29]. Although OPLA may have certain personality type that makes them less likely to be adherent in general, the higher prevalence of non-adherence observed among OPLA may be closely related to their beliefs about specific medications such as statins [30, 31]. This further emphasized the importance of the healthcare professional's role in counseling older persons, especially those living alone, to identify reasons for non-adherence, address potential misconceptions and establish the right understanding of their cholesterol medication.

On the other hand, simvastatin was implicated with seven DRPs related to "incorrect dosing instructions" and "prescribed dose too high" in this study. Based on recommended guidelines for cholesterol management, simvastatin should be taken in the evening for maximum efficacy and at doses not exceeding 20 mg per day when used concurrently

Table 2 Comparison of the prevalence of drug-related problems (DRP) by categories and drug classes between older persons living alone and those living with others

Identified DRP	Total (n = 360) n (%)	Living alone (N = 152) n (%)	Living with others (N = 208) n (%)	*p* value
Types of DRP category and subcategory				
Drug selection	36 (10.0)	18 (11.8)	18 (8.7)	0.319[a]
Duplication	12 (3.3)	7 (4.6)	5 (2.4)	0.250[a]
Drug interaction	21 (5.8)	10 (6.6)	11 (5.3)	0.606[a]
No indication apparent	5 (1.4)	3 (2.0)	2 (1.0)	0.654[b]
Over or under dose	27 (7.5)	12 (7.9)	15 (7.2)	0.808[a]
Prescribed dose too high	12 (3.3)	2 (1.3)	10 (4.8)	0.080[b]
Prescribed dose too low	8 (2.2)	6 (3.9)	2 (1.0)	0.075[b]
Incorrect dosing instruction	3 (0.8)	2 (1.3)	1 (0.5)	0.576[b]
Unclear dosing instruction	4 (1.1)	2 (1.3)	2 (1.0)	1.000[b]
Compliance	150 (41.7)	72 (47.4)	78 (37.5)	0.061[a]
Taking too little	90 (25.0)	51 (33.6)	39 (18.8)	**0.001**[a]
Taking too much	21 (5.8)	10 (6.6)	11 (5.3)	0.606[a]
Other compliance problem[c]	66 (18.3)	26 (17.1)	40 (19.2)	0.607[a]
Education or information	28 (7.8)	13 (8.6)	15 (7.2)	0.639[a]
Request drug information	27 (7.5)	12 (7.9)	15 (7.2)	0.808[a]
Request disease advice	1 (0.3)	1 (0.7)	0 (0.0)	0.422[b]
Toxicity or adverse effects	29 (8.1)	15 (9.9)	14 (6.7)	0.280[a]
Adverse effects	29 (8.1)	15 (9.9)	14 (6.7)	0.280[a]
Top ten drug classes involved in DRP[d]				
[C10AA] Statins	39 (10.8)	23 (15.1)	16 (7.7)	**0.025**[a]
[A02BC] Proton pump inhibitors	29 (8.1)	13 (8.6)	16 (7.7)	0.767[a]
[B01AC] Anti-platelets	23 (6.4)	13 (8.6)	10 (4.8)	0.151[a]
[A10BA] Biguanides	21 (5.8)	8 (5.3)	13 (6.3)	0.693[a]
[A12AA] Calcium	19 (5.3)	10 (6.6)	9 (4.3)	0.345[a]
[C08CA] Dihydropyridine calcium channel blocker	18 (5.0)	7 (4.6)	11 (5.3)	0.769[a]
[C09AA] ACE inhibitors	17 (4.7)	10 (6.6)	7 (3.4)	0.156[a]
[M01AX] Non-steroidal anti-inflammatory and anti-rheumatic agents	16 (4.4)	8 (5.3)	8 (3.8)	0.519[a]
[A10BB] Sulfonylureas	16 (4.4)	6 (3.9)	10 (4.8)	0.696[a]
[C07AB] Selective beta blocking agents	12 (3.3)	7 (4.6)	5 (2.4)	0.250[a]

[a]Chi square test; statistically significant *p* values in bold

[b]Fisher's exact test; statistically significant *p* values in bold

[c]Other compliance problem refers to non-compliance with instructions on administration of medicines with regards to food and timing

[d]Drug classified according to anatomical therapeutic chemical (ATC) coding system

with amlodipine so as to reduce the risk for adverse muscle effects such as rhabdomyolysis [32]. The presence of such DRPs demonstrated the need for judicious prescribing of statins and interventions to improve community-based pharmaceutical care services for community-dwelling older persons so as to ensure the effective yet safe use of statins.

There were several limitations in this study. Firstly, this study was conducted at SACs where most participants are financially needy and living in one- or two-room flats. Therefore, caution should be taken when generalizing the findings to the entire population of older persons. Secondly, direct comparison of the findings with other studies was challenging due to the wide variety of methodologies employed for the identification and classification of DRPs. Thirdly, this study provides only a conservative estimate on the number of DRPs at best due to the lack of completeness of medical information available such as laboratory results and prescriber's diagnoses. Identification of DRPs related to undertreatment and monitoring was precluded, as both of which requires these information. Furthermore, the identification of DRPs was performed by final year undergraduate students who may be inexperienced despite having received the same

pre-study training on interview techniques, protocol for data collection and management, as well as pharmaceutical care skills in terms of DRP identification. Despite these, almost half of the older persons in this study were reported to have at least one DRP. Lastly, although the prevalence of DRP between OPLA and those living with others was found to be statistically significant, the effect size (0.14) was deemed to be small. Further research could be carried out to investigate the DRP's clinical significance on the various health outcomes between the two older population groups compared in this study, and the impact of potential interventions in resolving DRPs among older persons, especially those living alone.

Conclusion

Besides having a significantly higher prevalence of DRP, OPLA were more likely to be non-adherent to their medications, particularly statins. Due to the presence of established social and communication channels from SAC, possible interventions for improving medication adherence to be explored in future may include community-based adherence counseling, pharmaceutical care services and/or reminder services. Future research should investigate the clinical significance of DRPs in the community and the impact of potential interventions in resolving DRPs among older persons, especially those living alone.

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