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Original Research Paper

The influence of beliefs and health literacy on medication-related outcomes in older adults: A cross-sectional study

Eman Rafhi [a,b,*], Ieva Stupans [a], Julie E. Stevens [a,c,d], Joon Soo Park [e,f], Kate N. Wang [a,b]

[a] Pharmacy, School of Health and Biomedical Sciences, RMIT University, Bundoora, VIC, 3083, Australia
[b] School of Allied Health, The University of Western Australia, Crawley, WA 6009, Australia
[c] Adelaide Medical School, Faculty of Health & Medical Sciences, University of Adelaide, Adelaide, SA 5005, Australia
[d] Clinical and Health Sciences, University of South Australia, Adelaide, SA 5000, Australia
[e] School of Engineering, Information Technology and Physical Sciences, Federation University Australia, Ballarat, VIC, 3350, Australia
[f] Institute for Sustainable Industries & Liveable Cities, Victoria University, Melbourne, VIC, 8001, Australia

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ABSTRACT

Background: Older adults often manage multiple chronic diseases which necessitates the use of multiple medicines. Nevertheless, they also face an elevated risk of harm when medicines are used inappropriately. Studies indicate that socioeconomic disadvantage, beliefs, and health literacy may correlate with non-adherence and inappropriate medicine use. However, older adults are underrepresented in the current body of literature.
Objective: To investigate the influence of beliefs and health literacy on medication-related outcomes in older adults.
Methods: Participants ≥65 years living in the community were invited to complete a survey. Participants were asked to report demographics, medicines and complete three questionnaires: Self-Efficacy for Appropriate Medication use Scale (SEAMS), Beliefs about Medicines Questionnaire (BMQ) and Health Literacy Questionnaire (HLQ). Descriptive statistics, regressions and correlations were calculated.
Results: A total of 154 participants were included in the analysis (35.7 % male, age range 65–110 y). Mean SEAMS score was 33.2 out of 39 (standard deviation (SD) = 8.0), reflecting high self-efficacy for adherence. Mean HLQ scores were high across the four scales measured in the survey (scales 1, 5, 6, and 9). Sixty-two participants (44.0 %) were using five or more medicines (polypharmacy) and 18 (15.4 %) reported use of a potentially inappropriate medicine. Regarding beliefs, mean BMQ-specific scores were as follows: necessity score 17.5 (SD = 5.1) and concern score 12.0 (SD = 4.0), indicating strong beliefs in the necessity of medicines and few concerns. Results of the regression analysis indicated that where the BMQ-Necessity scores were employed as the independent variable, there was statistical significance with polypharmacy ($p < 0.001$). Additionally, moderate positive correlations were identified between (1) necessity beliefs and both polypharmacy ($r = 0.401$, $p < 0.001$) and adherence ($r = 0.477$, $p < 0.001$), and (2) adherence and HLQ scale 5 ($r = 0.343$, $p < 0.001$), scale 6 ($r = 0.326$, $p < 0.001$) and scale 9 ($r = 0.320$, $p < 0.001$).
Conclusion: Older adults who perceive their medicines as necessary are more inclined to report use of multiple medicines, leading to polypharmacy. Additionally, older adults with stronger beliefs in the necessity of medicines and higher levels of health literacy demonstrate greater self-efficacy for adherence. Health professionals should consider evaluating necessity beliefs in older adults to manage potential non-adherence, reduce the risk of polypharmacy, and thereby mitigate the risk of suboptimal medicine use.

1. Introduction

Older adults often have multiple chronic diseases which subsequently necessitates the use of multiple medicines.[1] Given the challenges associated with managing multiple chronic health conditions and medicines, ensuring the appropriate and effective use of medicines in this population is imperative. As of June 30th, 2020, approximately 4.2 million Australians were aged 65 and over, representing 16 % of the total population.[2] While the use of medications is often essential to

* Corresponding author. 225-245 Plenty Road, Bundoora Victoria, 3082, Australia.
E-mail address: s3598938@student.rmit.edu.au (E. Rafhi).

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Abbreviations

BMQ	Beliefs about Medicines Questionnaire
HL	Health Literacy
HLQ	Health Literacy Questionnaire
PIM/s	Potentially Inappropriate Medicine/s
SD	Standard Deviation
SEAMS	Self-Efficacy for Appropriate Medication use Scale
SPSS	Statistical Package for Social Sciences

reduce the consequences of chronic diseases, older adults also face an elevated risk of harm when medicines are not used appropriately.[3,4] As a result, unfavourable medication-related outcomes can arise, such as hospitalisation, suboptimal medicine use as well as adverse drug reactions.[5,6]

Inappropriate use of medicines can result in therapeutic failure and can increase the risk of adverse events.[7] Suboptimal medicine use, a potential form of inappropriate medicine use, can result from factors such as polypharmacy, non-adherence, under-prescribing and the use of high-risk medicines such as potentially inappropriate medicines (PIMs). It has been reported that at least 250,000 hospital admissions annually are medication-related admissions with one in five admissions in older adults being medication-related.[8] It has also been reported that up to 55 % of patients admitted to a hospital in 2013 were prescribed a PIM and 6 % of admissions were due to the PIM.[9] While suboptimal medicine use can be a result of inappropriate medicine use, current research has suggested that socioeconomic disadvantage, beliefs, and health literacy may all correlate with non-adherence and inappropriate medicine use.[10–13]

Beliefs can manifest in various forms, including personal and cultural beliefs, as well as those shaped by personal experiences.[14,15] The healthcare journey is also a blend of social and individual experiences influenced by a person's culture, religion, tradition as well as experiences of their own and those of others.[14] To date, literature on the influence of beliefs in older adults is both conflicting and limited. Current research suggests that patients with a stronger belief in the necessity of their medicines with fewer concerns, demonstrate higher adherence to medicines with beliefs being identified as the most influential predictor of adherence.[16,17] Health beliefs and polypharmacy have also been identified as significant factors associated with inappropriate medication use.[18] Additionally, the relationship established between patients and their healthcare providers, such as doctors, are fundamental elements known to impact medication use.[19] These multifaceted elements collectively shape the way individuals perceive and navigate the world of healthcare, influencing their decisions, choices, and ultimately, their overall health outcomes.

Health literacy is defined as a person's ability to obtain, understand and use health information in a way which sustains wellbeing for themselves as well as others.[20] In recent years, health literacy has gained an increase in attention in its ability to drive clinical outcomes.[21] In 2006, approximately 42.6 % of Australians aged between 60 and 74 had health literacy skills that were considered 'less than adequate'.[22] It has also been reported that a large number of older Australians do not have the health literacy skills required to manage their health.[22] However, further research is needed to enhance our understanding of the associations present between health literacy and medicine use, particularly amongst older adults. Understanding these associations can potentially pave the way for more tailored healthcare interventions and improve health outcomes for this demographic.

Current research has shown that medication-related hospital admissions and medication safety issues within acute care settings remain significant challenges for the Australian healthcare system.[23] Although pharmacist-led medication reviews have been implemented to enhance medication management, further measures or interventions could prove beneficial in helping address this challenge. Investigation of the influence of other potential factors such as beliefs and health literacy may present as future factors to consider in minimising medicine-related harm. Research is needed to address how beliefs and healthy literacy may be influencing medication-related outcomes in older adults. The aim of this study is to investigate the influence of beliefs and health literacy on medication-related outcomes including suboptimal medicines use (polypharmacy, potentially inappropriate medicine use and adherence) in older adults.

2. Methods

2.1. Study design and setting

This cross-sectional study was conducted between December 2022 and August 2023 in Australia. Participants were recruited from Victoria and Western Australia via convenience sampling through use of both online and paper-based surveys.

2.2. Eligibility criteria and recruitment

Participants aged 65 years or above who had the capacity to provide informed consent were eligible to participate. Participants were recruited through QR code flyers and paper-based surveys distributed to pharmacies, independent aged-care villages, dental clinics, rotary clubs, word-of-mouth and advertisements placed in public locations as well as social media. Where participants were unable to navigate the QR code system, paper-based surveys were provided as an alternative. Each paper-based survey included a prepaid envelope, enabling participants to return the survey without incurring any postage costs. Prior to completing the survey, participants were provided with a participant information sheet and written, informed consent was obtained.

2.3. Survey design

The survey was designed to address a range of social and individual factors. Participants were asked to self-report demographics, medicines, chronic medical conditions, healthcare utilization and complete three validated questionnaires: The Self-Efficacy for Appropriate Medication use Scale (SEAMS),[24] Beliefs about Medicines Questionnaire (BMQ)[25] and the Health Literacy Questionnaire (HLQ).[26] To maximise the completion rates, only select scales from the HLQ were included (scales 1, 5, 6 and 9), while the BMQ and SEAMS were administered in full.

The SEAMs questionnaire, consisting of 13 items, assessed medication adherence self-efficacy with higher scores denoting a higher level of self-efficacy concerning adherence.[24] The BMQ, an 18-item scale used to assess participants' beliefs about their own medicines and medicines in general is made of two parts; the BMQ-Specific (10-items), which assesses a patient's beliefs about their own medicine/s and the BMQ-General (8-items), which assesses a patient's beliefs about medicines in general.[25] All items in the BMQ were scored on a five-point Likert scale ranging from "strongly disagree" to "strongly agree". The BMQ-specific is further comprised of two sub-scales: necessity and concern. A high score in the necessity domain indicates that patients think their medicines are important and necessary; higher scores in the concerns domain indicate that the patient is concerned about their medicines.[25] The BMQ-General is comprised of 2 sub-scales: overuse and harm. A higher score within each domain is indicative of stronger negative views about medicines in general.[25]

Health literacy was evaluated using the HLQ, and each domain score provided insights into specific aspects of health literacy.[26] The following scales from the HLQ were incorporated; Scale 1 (feeling understood & supported by healthcare providers), scale 5 (appraisal of health information), scale 6 (ability to actively engage with healthcare providers) and scale 9 (understanding health information well enough to know what to do).[26] The HLQ scales selected focused on reducing duplication of questions, whist obtaining relevant participant data, for example patient provider interactions – scales 1 and 6, thus minimising the risk of survey non-completion by participants.

2.4. Definitions

In this study, suboptimal medicine use was presented as a particular category of medication-related outcomes. Suboptimal medicine use in older adults was identified through the prevalence of polypharmacy, potentially inappropriate medicines (PIMs) and adherence (Table 1). Polypharmacy was defined as the use of at least five medicines, and hyperpolypharmacy as the use of at least 10 medicines.[27] Medicines were counted by the number of active ingredients in each product or preparation including prescribed and over-the-counter medicines (OTC), herbs, minerals, and vitamins. PIMs, which are defined as medicines where the potential risks often outweigh the anticipated benefits for older people, were assessed using the Australian PIMs list.[6] Despite the identification of a PIM, certain medicines may still be regarded as appropriate in situations where the rationale for their use is deemed appropriate. Inappropriate medicine use was determined by reviewing participants' self-reported conditions and medicines. Where participants were using medicines for an inappropriate indication or where its use was against current guidelines, this was classified as inappropriate.

2.5. Data analysis

Statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS) software version 29.0, as well as Python software version 3.11.0. Descriptive statistics, including mean, standard deviations, and percentages, were employed to provide a summary of the demographic data as well as data obtained from each validated tool (BMQ, SEAMS and HLQ).

For the BMQ-specific, participants were categorised into four attitudinal groups dependent on whether they scored above or below the scale mid-point, as implemented in previous studies[29].

- Skeptical (low necessity, high concerns)
- Indifferent (low necessity, low concerns)
- Ambivalent (high necessity, high concerns)
- Accepting (high necessity, low concerns)

Individual multivariate regressions (MANOVA) were computed to describe the association between potential predictors and suboptimal medicine use (e.g., non-adherence) ($\alpha = 0.05$). To reduce the risk of a Type I error, the Bonferroni correction was implemented, and the alpha values were adjusted accordingly for each analysis of variance (ANOVA) ($\alpha = 0.01667$).[30]

Table 1
Definition of key terms.

Terminology	Definition
Suboptimal medicine use	The use of medicines in a way which is less than optimal and not therapeutically appropriate.
Adherence	The process whereby a person is taking their medicine as prescribed, mutually agreed by both themself and the prescriber.[28]
Polypharmacy	The use of greater than or equal to 5 medicines concurrently.[27] Medicines were counted by the number of active ingredients in each product or preparation including prescribed and over-the-counter medicines (OTC). This includes vitamins, herbs, minerals and supplements. Hyperpolypharmacy was defined as the use of greater than or equal to 10 medicines concurrently.[27]
Potentially Inappropriate medicines (PIMs)	Medicines that be avoided in older adults due to their high risk of harm in this population.[6,27] PIMs were identified using the Australian PIMs list.[6]

The Pearson correlation coefficient was used to assess the linear relationship between variables. In this analysis, a significance level (α) of 0.05 was applied. The results of the Pearson correlation coefficient were interpreted based on established guidelines[31]: correlations between 0 and 0.3 (and between 0 and -0.3) indicated a weak positive or negative linear relationship, correlations between 0.3 and 0.7 (and between −0.3 and −0.7) suggested a moderate positive or negative linear relationship, and correlations between 0.7 and 1.0 (and between −0.7 and −1.0) indicated a strong positive or negative linear relationship.

2.6. Ethics and ethical considerations

Ethics was approved by the RMIT University Human Research Ethics Committee (#25397).

3. Results

3.1. Demographics

A total of 200 participants were recruited from Victoria and Western Australia. Of these, 45 participants were excluded due to incomplete survey submissions, and one participant was excluded for being under the age of 65. This led to a total of 154 participants for analysis. Among these participants, majority were female (n = 98, 63.6 %), with 35.7 % being male (Table 2). The age of participants ranged from 65 to 110 years (M = 75, SD = 8.2).

The five most commonly self-reported chronic health conditions were hypertension, hypercholesterolemia, diabetes, arthritis, and reflux (Table 2). Majority of participants did not live alone (n = 104, 67.5 %), identified themselves as having an Australian background (n = 77, 50.0 %), and reported having achieved a university degree as their highest level of education (n = 50, 32.5 %).

3.2. Beliefs about medicines

Participants' beliefs were assessed using the BMQ. In the BMQ-Specific participants recorded a mean necessity score of 17.5 (SD = 5.1) and concern score of 12.0 (SD = 4.0), indicating that participants held strong beliefs in the necessity of their medicines in maintaining their health and few concerns. Comparatively, in the BMQ-General, participants recorded a mean overuse score of 11.9 (SD = 3.3) and harm score of 8.7 (SD = 2.9), indicating that they held few negative beliefs regarding the potential harm and overuse of medicines (Supplementary Table 1).

Using the BMQ-specific scores, participants were categorised into four attitudinal groups (Fig. 1).[29,32] Among the 141 participants who completed the BMQ-Specific, 53.9 % (n = 76) were categorised as "Accepting", 26.2 % (n = 37) were 'Indifferent", 19.9 % (n = 28) were "Ambivalent" and none of the participants fell into the "Skeptical" group (Fig. 1). These results further emphasize that 53.9 % (accepting group) of participants believed in the importance and necessity of their medicines with fewer concerns about medicines, followed by 26.2 % of participants who held the belief that while they also held fewer concerns about their medicines, they did not believe in the necessity of their medicines.

3.3. Health literacy

Using domains of the HLQ, participants ability to understand health information and engage with healthcare providers was assessed. For all four scales (Scale 1,5, 6 and 9), participants recorded high mean scores [Scale 1 (feeling understood & supported by healthcare providers) (M = 12.3, SD = 2.8), Scale 5 (appraisal of health information) (M = 14.2, SD = 2.7), Scale 6 (ability to actively engage with healthcare providers) (M = 19.5, SD = 3.6), Scale 9 (understanding health information well

Table 2
Demographics, health characteristics and conditions reported by participants (n = 154).

Age (years), mean ± SD	75.2 ± 8.2
Sex[a], n (%)	
Male	55 (35.7)
Female	98 (63.6)
Prefer not to say	1 (0.6)
Background[b], n (%)	
Australian	77 (50.0)
Non-Australian	77 (50.0)
Education[a], n (%)	
Primary school or less	10 (6.5)
Secondary school or equivalent (completed)	37 (24.0)
Secondary school or equivalent (not completed)	29 (18.8)
TAFE/Trade	9 (5.8)
University	50 (32.5)
Other post-secondary training/qualification	17 (11.0)
Not reported	2 (1.3)
Living Situation, n (%)	
Live alone	50 (32.5)
Do not live alone	104 (67.5)
Aboriginal or Torres Strait Islander, n (%)	
Yes	1 (0.6)
No	153 (99.4)
Main Language Spoken at Home, n (%)	
English	117 (76.0)
Non-English	37 (24.0)
Healthcare or Pensioner Card, n (%)	
Yes	117 (76.0)
No	37 (24.0)
Self-reported conditions (n = 121), n (%)[c]	
Hypertension	83 (68.6)
Hypercholesterolemia	64 (52.9)
Diabetes	29 (24.0)
Arthritis	27 (22.3)
Reflux	23 (19.0)
Heart Condition	21 (17.4)
Asthma	12 (9.9)
Hypothyroidism	11 (9.1)
Osteoporosis	8 (6.6)
Depression	7 (5.8)
Gout	5 (4.1)
Arrythmia	5 (4.1)
Autoimmune disease[d]	5 (4.1)
Chronic Pain	4 (3.3)
Insomnia	3 (2.5)
Hyperthyroidism	2 (1.7)
Restless Leg Syndrome	2 (1.7)
Chronic Obstructive Pulmonary Disease	2 (1.7)
Anxiety	2 (1.7)
Urinary Incontinence	2 (1.7)
Macular Degeneration	2 (1.7)
Other[e]	12 (9.9)
Eyesight, n (%)	
Normal	54 (35.1)
Poor eyesight	10 (6.5)
Uses glasses	88 (57.1)
Blind	0 (0)
Not reported	2 (1.3)
Hearing, n (%)	
Normal	108 (70.1)
Poor hearing	18 (11.7)
Uses hearing aids	26 (16.9)
Deaf	0 (0)
Not reported	2 (1.3)

[a] The percentages do not aggregate to 100% due to rounding to one decimal place.
[b] Defined for the purpose of this study as a person's ethnicity or race.
[c] *n = 33*, Participants did not self-report any chronic health conditions.
[d] Whereby four were an autoimmune form of arthritis: psoriatic arthritis (*n = 1*), Rheumatoid arthritis (*n = 3*).
[e] Cerebrovascular disease, Osteopenia, Human Immunodeficiency Virus, Low Blood Pressure, Migraines, Irritable Bowel Syndrome, Barret's Oesophagus, Addison's Disease, Breast Cancer, Spleen Cancer, Thyroid Cancer and Hiatus hernia.

enough to know what to do) (M = 19.8, SD = 3.80], as presented in Supplementary Table 2. This indicates that recruited participants had the health literacy levels required to address the health literacy themes of the domains assessed.[26]

According to results from the HLQ, certain statements resonated more strongly with participants (Supplementary Tables 3 and 4). A significant portion, specifically 57.2 % of participants (n = 83), agreed that they have at least one healthcare provider with whom they feel comfortable discussing their health problems and finding solutions. Furthermore, 59.9 % (n = 85) and 61.3 % (n = 87) expressed confidence in their ability to determine the accuracy of health information they receive and inquiring about the quality of health information with their healthcare providers, respectively.

In addition, 53.4 % (n = 78) of participants reported that they usually found it easy to engage in discussions with healthcare providers until they comprehended all the information they needed, and 54.1 % (n = 79) indicated that they could accurately follow instructions provided by healthcare providers.

3.4. Suboptimal medicine use

3.4.1. Polypharmacy and medicine use

Majority of participants (n = 138, 89.6 %) were able to provide a list of their medicines or specified that they were not using any medicines. Among the remaining 16 participants who did not report their medicines, 13 confirmed that they were using medicines but did not disclose the name of those medicines, while three reported the therapeutic indication but also did not specify the drug. Among the 138 participants where a participants' medicines list was obtained, the average number of medicines used was 4.4 (SD = 3.6). Polypharmacy was identified in 49 participants (34.8 %), and hyperpolypharmacy, which signifies the use of an extensive number of medications, was observed in 13 participants (9.2 %). This resulted in a cumulative total of 62 participants (44.0 %) who were using five or more medicines (Table 3).

Most participants (n = 144, 93.5 %) were capable of self-administering their medicines, while a small proportion of 8 participants (5.2 %) required assistance from either a caregiver, family member, or the use of dose administration aids.

3.5. Self-efficacy and adherence

Participants recorded a mean SEAMS score of 33.2 (SD = 8.0), signifying that the majority of recruited participants possessed a high level of self-efficacy when it came to medication adherence (Supplementary Table 5). Of the 142 participants for whom a SEAMS score was calculated, a substantial number, comprising 68.7 % (n = 106), attained a high total score of greater than or equal to 30 (Supplementary Table 6). The lowest recorded score was a score of two observed in only one participant. This suggesting that the majority of participants demonstrated a high level of self-efficacy regarding medication adherence.

3.6. Potentially inappropriate medicines

Of the 154 participants included for analysis, 117 participants provided report of their medicines. Among the remaining 37 participants where a medicines list could not be obtained, participants either declined to disclose their medicines or reported that they were currently not using any. Of the 117 participants where a medicines list was obtained, 18 participants reported use of a PIM and one reported signs of inappropriate use (Table 4).

3.7. Association between potential predictors (beliefs and HL) and suboptimal medicine use

To examine the association between potential predictors and

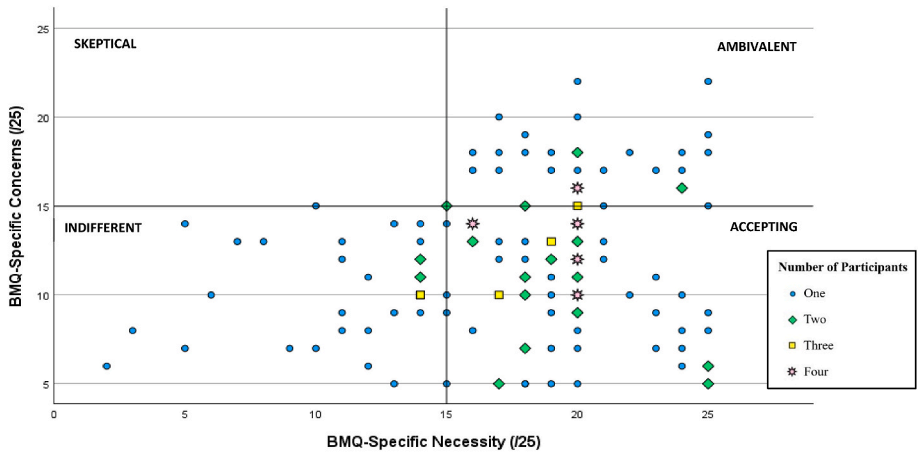

Fig. 1. Attitudinal Analysis of participants beliefs about medicines *(n = 141)*. Each plotted data point represents one or more participants. Where a circle has been plotted, this indicates one participant, a diamond represents two participants, a square signifies three participants, and a star denotes four participants. Among participants, 53.9 % were categorised as "accepting," 26.2 % as "indifferent," 19.9 % as "ambivalent," and none as "skeptical". This indicating that over half of the participants reported strong beliefs in the importance and necessity of their medicines with few concerns.

Table 3a
Self-reported healthcare utilization and medicine use *(n = 154)*.

	Mean ± SD[a]
Number of General Practitioners (GPs)[b]	1.2 ± 0.5
Number of Specialists	1.1 ± 1.1
Number of Hospitalisations (annual)[c]	0.3 ± 0.7
Number of Emergency Department Visits (annual)	0.3 ± 0.7
Number of medicines[d]	4.4 ± 3.6

[a] Average per participant.
[b] n = 152, two participants did not report to their number of GPs.
[c] n = 153, one participant did not report whether or not they were hospitalised in the past 12 months.
[d] n = 141, thirteen participants did not report their medicines.

Table 3b
Medicine use and Management *(n = 154)*.

	n (%)
Polypharmacy[a]	49 (34.8)
Hyperpolypharmacy[a]	13 (9.2)
No. of Participants using ≥ 5 medicines[a]	62 (44.0)
Participants prescribed a PIM[b]	18 (15.4)
Medication Management	
Self	144 (93.5)
Family	4 (2.6)
Dose Administration Aids	2 (1.3)
Carer	2 (1.3)
Not applicable – No medicines	3 (1.9)

[a] n = 141, thirteen participants did not report their medicines.
[b] n = 117, thirty-seven participants declined to disclose their specific medicines or were currently not using any.

suboptimal medicine use (adherence, polypharmacy and PIMs), three separate multivariate regressions (MANOVA) were conducted for the HLQ, BMQ-Specific and BMQ-General.

Results of the multivariate regression indicate statistical significance between participants BMQ-Specific necessity scores and the combined dependent variables (PIMs, Self-efficacy for adherence, and polypharmacy), with Wilks' $\Lambda = 0.135$, $p < 0.05$ (refer to Table 5). However, the BMQ-specific concerns score yielded no significance with the dependent variables analysed. Results of the remaining MANOVAs also yielded no significance between the independent variables (HLQ and BMQ-General) and the dependent variables (polypharmacy, PIMs and self-efficacy for adherence). Additionally, separate ANOVAs were performed for each dependent variable.

Table 4
Participants reporting use of a PIM or inappropriate medicine use.

Participant ID	PIM/Inappropriate Use[a]
1	Diclofenac (Participant also hypertensive)
2	Codeine
3	Meloxicam (Participant also hypertensive)
4	Meloxicam (Participant also hypertensive)
5	Diclofenac (Participant also hypertensive)
6	Meloxicam (Participant also hypertensive)
7	Rivaroxaban
8	Meloxicam (Participant also hypertensive) Codeine.
9	Oxybutynin (Also using concurrently with umeclidinium – anticholinergic, potentially inappropriate.)
10	Ketoprofen
11	Therapeutic drug duplication: (1) Concurrent use of SNRI (Venlafaxine) and SSRI (Mirtazapine). (2) Concurrent use of inhaled corticosteroids budesonide and mometasone.
12	Meloxicam (Patient also diagnosed with AF) Rivaroxaban
13	Rivaroxaban
14	Oxybutynin
15	Methyldopa[b] Prazosin[b]
16	Oxybutynin
17	Zolpidem[c]
18	Oxybutynin Doxylamine[d]
19	Ibuprofen (Participant also hypertensive)

[a] PIMs were assessed using the Australian PIMs list[6] while inappropriate medicine use was determined by reviewing participants' self-reported conditions and medicines. Where participants were using medicines for an inappropriate indication or where its use was against current guidelines, this was classified as inappropriate.
[b] Participant presents with knee disability, use of this PIM further increases risk of falls, frailty, and hypotension.
[c] Diagnosed with osteoporosis, use of PIM further increases risk of falls and frailty.
[d] When used in combination with other anticholinergics (i.e. Oxybutynin).

Using the Bonferroni method, each ANOVA was tested at an alpha level of 0.01667 (0.05/3). Where the BMQ-General (both Harm and Overuse subscales) scores served as the independent variable, no statistical significance was found with participants' self-efficacy for adherence, the use of a PIM or polypharmacy. Similarly, where scores of each HLQ scale served as the independent variable, no statistical significance was found with participants' self-efficacy for adherence to

Table 5
Multivariate regression (MANOVA) of beliefs about medicines, HLQ and suboptimal medicine use[a].

MANOVA No. 1		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
BMQ Overuse	Wilks' Lambda	0.532	1.133	48.000	229.811	0.270	0.190
BMQ Harm	Wilks' Lambda	0.655	0.835	42.000	229.184	0.754	0.131
BMQ Overuse and Harm	Wilks' Lambda	0.224	1.189	126.000	231.630	0.129	0.392
MANOVA No. 2							
BMQ Concern	Wilks' Lambda	0.303	1.304	51.000	134.778	0.116	0.328
BMQ Necessity	Wilks' Lambda	0.135	1.792	72.000	135.344	0.002[b]	0.487
BMQ Concern and Necessity	Wilks' Lambda	0.077	0.974	189.000	135.872	0.568	0.575
MANOVA No. 3							
HLQ Scale 1	Wilks' Lambda	0.630	0.485	24.000	67.308	0.975	0.143
HLQ Scale 5	Wilks' Lambda	0.369	0.835	33.000	68.466	0.712	0.283
HLQ Scale 6	Wilks' Lambda	0.360	0.861	33.000	68.466	0.677	0.289
HLQ Scale 9	Wilks' Lambda	0.721	0.335	24.000	67.308	0.998	0.103

Prior to conducting each MANOVA, fulfillment of all four assumptions was confirmed, including multivariate normality, independence, equal variance, and absence of multivariate outliers. Concerning equal variance, we employed Box's M test with an alpha significance level of 0.001. In all three regressions, the equal variance assumption was met.
Inputted dependent variables: PIMS, Polypharmacy and SEAMS scores.
[a] Covariates; Age and Gender.
[b] $p \leq 0.05$.

medicines, the use of a PIM or polypharmacy. However, where the BMQ-Necessity scores were employed as the independent variable, there was statistical significance with polypharmacy, $p \leq 0.01667$ (Table 6).

3.8. Relationship between variables

A Pearson correlation coefficient was performed to assess the relationship between BMQ and HLQ scores with respect to the utilization of a PIM, polypharmacy, adherence, and education level. Prior to conducting the analysis, we verified the fulfillment of four assumptions: the

Table 6
Analysis of variance (ANOVA) of BMQ and HLQ against dependent variables[a].

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F (Sig.)	Partial Eta Squared
ANOVA No. 1 – Test of Between-Subject Effects						
BMQ Overuse	PIMs	9.223	16	0.576	1.216 (0.275)	0.198
	Polypharmacy	18.730	16	1.171	1.591 (0.091)	0.244
	SEAMS	1214.686	16	75.918	0.738 (0.747)	0.130
BMQ Harm	PIMs	5.681	14	0.406	0.856 (0.608)	0.132
	Polypharmacy	9.944	14	0.710	0.965 (0.496)	0.146
	SEAMS	1165.100	14	83.221	0.809 (0.657)	0.125
BMQ Overuse and Harm	PIMs	23.014	42	0.548	1.156 (0.286)	0.381
	Polypharmacy	40.809	42	0.972	1.320 (0.143)	0.412
	SEAMS	5510.581	42	131.204	1.276 (0.175)	0.404
ANOVA No. 2 – Test of Between-Subject Effects						
BMQ Concern	PIMs	6.470	17	0.381	0.801 (0.683)	0.225
	Polypharmacy	12.525	17	0.737	1.338 (0.212)	0.326
	SEAMS	2406.629	17	141.566	1.421 (0.170)	0.340
BMQ Necessity	PIMs	9.501	24	0.396	0.834 (0.679)	0.299
	Polypharmacy	38.885	24	1.620	2.943 (<0.001[b])	0.600
	SEAMS	4514.990	24	188.125	1.889 (0.031)	0.491
BMQ Concern and Necessity	PIMs	35.600	63	0.565	1.190 (0.268)	0.615
	Polypharmacy	50.315	63	0.799	1.451 (0.092)	0.660
	SEAMS	3357.276	63	53.290	0.535 (0.990)	0.418
ANOVA No. 3 – Test of Between-Subject Effects						
HLQ Scale 1	PIMs	1.928	8	0.241	0.397 (0.912)	0.113
	Polypharmacy	4.401	8	0.550	0.764 (0.637)	0.196
	SEAMS	488.824	8	61.103	0.356 (0.934)	0.102
HLQ Scale 5	PIMs	6.819	11	0.620	1.021 (0.457	0.310
	Polypharmacy	8.771	11	0.797	1.108 (0.396)	0.328
	SEAMS	929.955	11	84.541	0.493 (0.890)	0.178
HLQ Scale 6	PIMs	5.706	11	0.519	0.854 (0.592)	0.273
	Polypharmacy	11.710	11	1.065	1.479 (0.201)	0.394
	SEAMS	666.869	11	60.624	0.354 (0.963)	0.135
HLQ Scale 9	PIMs	1.965	8	0.246	0.405 (0.907)	0.115
	Polypharmacy	2.243	8	0.280	0.389 (0.916)	0.111
	SEAMS	352.759	8	44.095	0.257 (0.974)	0.076

[a] Covariates; Age and Gender.
[b] $p \leq 0.01667$.

variables were measured at the interval level, there existed a linear relationship (determined by the significance of deviation from linearity, $p < 0.05$), normality was assumed, and outliers were absent. Results of the Pearson correlation analysis exhibited a moderate positive correlation between beliefs regarding the necessity of medicines (BMQ-Necessity) and both polypharmacy and self-efficacy for adherence (SEAMs scores), respectively. A moderate positive correlation was also observed between participants self-efficacy for adherence (SEAMs scores) and HLQ scales: scale 5 (appraisal of health information), scale 6 (ability to actively engage with healthcare providers) and scale 9 (understanding health information well enough to know what to do). However, the remaining outcomes of the Pearson correlation analysis indicated non-significant relationships among the variables in each respective test, with all results indicating weak correlations, as presented in Table 7.

4. Discussion

This is the first cross-sectional Australian study, to the best of our knowledge, to investigate the influence of beliefs and health literacy on medication-related outcomes in older adults. The findings of this paper indicate that there exists a significant association between beliefs about medicines and both polypharmacy and adherence to medicines among older adults in Australia. More specifically, participants who exhibited stronger beliefs in the necessity of their medicines were more likely to use greater than or equal to five medicines (polypharmacy) and demonstrate higher self-efficacy for adherence. However, no significant associations were present between beliefs about medicines and use of a PIM or inappropriate medicine use. Additionally, participants demonstrated a moderate positive correlation between adherence and health literacy levels associated with the appraisal and understanding of health information, as well as engagement with healthcare providers. However, no significant associations were established between health literacy and polypharmacy or inappropriate medicine use. While prevailing literature highlights the importance of necessity beliefs in fostering adherence,[15–17,33,34] there has been limited exploration of its implications on older adults, and virtually few have delved into the impact of patient beliefs on polypharmacy, rendering these findings noteworthy.

These findings highlight the importance of considering patient beliefs in medication management interventions for older adults. Understanding and addressing patient beliefs about medication necessity may contribute to more effective medication management strategies and improved adherence among older adults. The results of this study are consistent with previous literature in suggesting that necessity beliefs play a significant role in promoting adherence.[16,17,33,34] According to the attitudinal analysis of the BMQ, more than half of the participants were classified as "accepting" of their medications, characterised by high necessity beliefs and few concern beliefs. Existing literature, which includes populations beyond older adults, has similarly reported that most participants were categorised as "accepting" of their medications and these participants reported better adherence.[35,36] However, this study also differs from prior findings by indicating that concern beliefs were not found to necessarily reduce adherence in patients who demonstrated stronger beliefs regarding the concern and use of their medicines.[37–39] Despite most participants reporting stronger necessity beliefs and fewer concerns regarding their medicines, concern beliefs did not significantly influence adherence or lead to poor adherence. Consequently, based on these findings, necessity beliefs emerged as the sole predictor of adherence, outweighing the influence of concern beliefs in fostering adherence.

Older Australians who perceived their medicines as necessary were more inclined to indicate concurrent use of multiple medicines, leading to polypharmacy. This trend may stem from various factors. Participants who present with stronger beliefs in the necessity of medicines may be more inclined to follow medical advice,[29] or initiate use of over-the-counter medicines, gradually accumulating multiple medications over time. A previous mixed-methods study of older adults revealed that patients also described their medicine as necessary to keep them "ticking over".[29] In addition, stronger beliefs in the necessity of medicines could overshadow an individual's ability to perceive potential risks or the overuse of medicines, further exacerbating the likelihood of polypharmacy. This is particularly noteworthy considering that this study is among few which examine the influence of beliefs on polypharmacy. Most participants involved in this study also presented with multimorbidity, increasing their susceptibility to polypharmacy and, conversely, inappropriate medicine use. Nevertheless, the majority expressed positive attitudes towards their healthcare provider/s. However, although a positive patient-provider relationship has been shown to enhance adherence and health outcomes,[19] additional research may be required to elucidate its role in mitigating the risks associated with polypharmacy. Previous research has highlighted the significance of beliefs in shaping individuals' perceptions of polypharmacy, as well as the crucial role of patient-provider relationships in influencing willingness to deprescribe.[29,40] In summary, a belief in the necessity of medicines can fuel polypharmacy by fostering a mindset that prioritizes medicines without sufficient consideration of the cumulative effects of multiple medicines.

While health literacy plays a crucial role in health-related decision-making,[21,41] its direct influence on medication-related outcomes, beyond adherence, appears limited in this population. Still, the findings of this study are consistent with existing literature, which suggests a positive association between health literacy levels and adherence among older adults.[21,43] Future research should explore additional factors or

Table 7
Pearson Correlation Coefficient (r) of BMQ and HLQ scores, with respect to the utilization of a PIM, polypharmacy, adherence, and education level*.

*α = 0.05 ** Moderate positive correlation		Polypharmacy	PIM	SEAMS Score	Education Level
BMQ-General Overuse	Pearson Correlation (r)	−0.030	−0.138	0.289	−0.078
	Sig. (2-tailed)	0.715	0.087	<0.001	0.335
BMQ-General Harm	Pearson Correlation (r)	0.013	−0.070	0.220	−0.153
	Sig. (2-tailed)	0.876	0.388	0.006	0.058
BMQ-Specific Concerns	Pearson Correlation (r)	0.130	−0.067	0.224	−0.133
	Sig. (2-tailed)	0.109	0.407	0.005	0.101
BMQ-Specific Necessity	Pearson Correlation (r)	0.401**	−0.106	0.477**	0.045
	Sig. (2-tailed)	<0.001	0.192	<0.001	0.578
HLQ Scale 1	Pearson Correlation (r)	0.174	−0.033	0.299	0.134
	Sig. (2-tailed)	0.031	0.685	<0.001	0.099
HLQ Scale 5	Pearson Correlation (r)	0.179	−0.080	0.343**	0.168
	Sig. (2-tailed)	0.026	0.322	<0.001	0.038
HLQ Scale 6	Pearson Correlation (r)	0.162	0.016	0.326**	0.138
	Sig. (2-tailed)	0.045	0.846	<0.001	0.087
HLQ Scale 9	Pearson Correlation (r)	0.168	−0.027	0.320**	0.207
	Sig. (2-tailed)	0.037	0.739	<0.001	0.010

alternative health literacy dimensions contributing to medication-related outcomes and investigate tailored interventions to address medication-related issues among older adults in Australia. Furthermore, despite the escalating concern of inappropriate medicine use among Australia's expanding elderly population, neither beliefs nor health literacy emerged as significant determinants in the adoption of potentially inappropriate medicines (PIMs). This observation persists notwithstanding reports of PIM use among a subset of participants ($n = 18$), with meloxicam being the most frequently reported PIM.

5. Implications for practice

The findings of this research shed light on the intricate interplay of factors contributing to medication-related outcomes among older adults, particularly on adherence and polypharmacy.

Health professionals should consider prioritising an assessment of necessity beliefs and health literacy levels in older adults to address potential adherence challenges effectively. This can be done using validated tools such as the Beliefs about Medicines Questionnaire (BMQ) and the Health Literacy Questionnaire (HLQ) during routine medical reviews or consultations. Alternatively, health professionals may choose to initiate a discussion about the necessity and perceived benefits of medications. For instance, health professionals could ask patients to reflect on why they believe a medication is important and how it affects their daily functioning. By actively engaging with patients about the importance they attribute to their medicines, health professionals can better understand their patients' perspectives and identify older adults at risk of non-adherence. For patients expressing doubts about the necessity of their medications, tailored interventions can be provided. These should emphasize the importance and benefits of their medicines and adherence while balancing the discussion of potential side effects and risks associated with polypharmacy. Furthermore, evaluating participants' necessity beliefs could aid in mitigating the risks associated with both non-adherence and polypharmacy.

The patient-prescriber relationship also emerges as a pivotal factor influencing individuals' perceptions of polypharmacy. To mitigate the risk of polypharmacy, deprescribing initiatives that frame the process positively are critical. Implementing a structured deprescribing process, in which older adults are guided by healthcare professionals to gradually reduce or discontinue unnecessary medications, could effectively alleviate medication burden. Regular medication reviews should be conducted to assess the necessity of each medication in the context of the patient's comorbidities. By framing deprescribing as an opportunity to enhance the quality of life and reduce the potential for adverse effects, patients may feel more inclined to accept these changes. Ensuring patients understand that deprescribing is a collaborative process that prioritizes their well-being can make a significant impact. The use of shared decision-making tools, such as decision aids, can assist patients in visualising the risks associated with polypharmacy and considering the benefits of reducing unnecessary medications. In light of these findings, healthcare professionals are encouraged to incorporate necessity belief assessments into their practice to foster adherence and mitigate the risks of polypharmacy among older adults.

6. Strengths and limitations

The recruitment of participants from diverse locations, including those from both metropolitan and rural areas, contributed to enhanced geographical diversity. This diverse sample enriches the generalisability of the study's findings, allowing for broader applicability across varied populations. Furthermore, offering participants the choice between online completion and traditional paper-based surveys, including prepaid return envelopes, captured participants of diverse preferences and accessibility needs – enhancing the generalisability of the findings. This approach also fostered participant comfort and inclusivity, particularly benefiting those without internet access or technological proficiency.

Despite these strengths, the study had a few limitations. Firstly, the use of self-reported questionnaires to measure adherence introduces the potential for bias, as participants may inaccurately represent their adherence levels. Similarly, relying on self-reported data for chronic disease status may lead to recall bias, where participants may not accurately recall or report their medical history.[42] The recruitment of participants through convenience sampling may have also introduced representation bias, limiting the diversity of the sample. Lastly, due to the sample size, the findings may not be generalisable to the broader population of older adults. Future research should aim to include a larger and more diverse sample to enhance the generalisability of the results.

7. Conclusion

Older adults with a stronger belief in the necessity of their medicines are more likely to engage in polypharmacy and exhibit higher self-efficacy for adherence. The importance placed on necessity beliefs also appears to be more influential than concern beliefs in promoting adherence. In our study group, higher levels of health literacy were positively associated with adherence, however the impact of health literacy on other medication-related outcomes among older adults appears limited. Further research should investigate other domains contributing to medication-related outcomes. Health professionals should consider evaluating necessity beliefs in older adults to manage potential non-adherence and mitigate the risk of polypharmacy.

CRediT authorship contribution statement

Eman Rafhi: Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Ieva Stupans:** Writing – review & editing, Supervision. **Julie E. Stevens:** Writing – review & editing, Supervision. **Joon Soo Park:** Writing – review & editing, Supervision, Formal analysis. **Kate N. Wang:** Writing – review & editing, Supervision.

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Declaration of competing interest

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Dr Kate Wang reports a relationship with Australian Korean Foundation that includes: funding grants. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

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