Drugs - Real World Outcomes (2023) 10:23–29
https://doi.org/10.1007/s40801-023-00352-8

SHORT COMMUNICATION

Self-Reported Medication Adherence Among Older People Admitted to Hospital: A Descriptive Study

Shayma Irshaidat[1] · Maria Gustafsson[1] · Helena Norberg[1]

Accepted: 8 January 2023 / Published online: 26 January 2023

Abstract

Background Poor medication adherence is prevalent among older people. To optimize therapeutic outcomes, it is crucial to understand the underlying causes and perceptions.

Objective We aimed to investigate the extent of self-reported medication adherence and associated factors among older people admitted to hospital.

Methods Individuals living at home aged ≥ 75 years with an emergency admission at a university hospital between September 2018 and September 2021 were included. Participants answered the Medication Adherence Report Scale (MARS-5) questionnaire upon admission regarding their prescribed long-term medications. Participants with a MARS-5 score of 23–25 were defined as adherent and with a score of 5–22 as nonadherent. A multivariable logistic regression analysis was performed to investigate possible factors independently associated with self-reported medication adherence.

Results A total of 261 individuals were included. The mean age was 84 years (standard deviation 5.7) and the mean MARS-5 score was 23.9 (standard deviation 1.8). Overall, 227 (87%) participants were classified as adherent to their prescribed treatment, while 34 (13%) participants were classified as nonadherent. Participants with cognitive impairment (odds ratio = 0.40, 95% confidence interval 0.18–0.90, $p = 0.027$) and depression (odds ratio = 0.29, 95% confidence interval 0.10–0.87, $p = 0.028$) had a lower odds of reporting adherence to their medications.

Conclusions The majority of individuals aged ≥ 75 years who were recently hospitalized rated themselves as adherent to their prescribed medications according to MARS-5. Future studies would benefit from adding more possible explanatory factors and combining a self-reported assessment with a more objective measurement of medication adherence.

Key Points

Older people's perceptions of their medication adherence might be a barrier that affects therapeutic outcomes.

In this population of older people who were healthy enough to be living at home, yet with a morbidity requiring emergency care, self-reported medication adherence was high.

Medication adherence is complex and future studies need to apply more multidimensional methods.

✉ Helena Norberg
helena.norberg@umu.se

[1] Department of Integrative Medical Biology, Umeå University, 901 87 Umeå, Sweden

1 Introduction

Medication adherence is the process by which patients take their medications as prescribed, and comprises three components: initiation, implementation, and discontinuation [1]. Good medication adherence is vital for achieving beneficial therapeutic outcomes and reducing healthcare costs [2–4]. In older adults, poor adherence to drug therapy has been reported in 26–59% of cases, depending on the population and methods used to assess adherence [5–9]. Understanding the underlying factors affecting medication adherence is crucial for optimizing therapeutic outcomes [10].

As early as 2003, the World Health Organization observed that increasing the effectiveness of adherence interventions may have a greater impact on public health than further improvement in specific medical therapies [11]. In more recent research, the main barriers for maintaining long-term adherence in older people have been reported to be, for example,

polypharmacy, forgetfulness, difficulty taking the drug, perceived side effects, lack of belief in the drug, costs, cognitive impairment, negative mood, and perceived poor health [6, 9, 12–15]. In addition, Kardas et al. extracted over 770 determinants of patient adherence to long-term therapies in a review of systematic reviews [16]. The majority were factors of implementation, followed by factors of persistence with medication. This result illustrates that medication adherence is complex and multidimensional.

Because previous literature has shown that poor medication adherence is prevalent among the growing population of older people, it is important to learn more about the underlying factors affecting adherence in order to optimize the management of chronic diseases [10]. Of special interest for investigating these factors are older people healthy enough to be living at home, as these individuals generally have many medications prescribed and are still managing their own medications. The focus of the present study is to investigate how older people perceive their medication adherence at home regarding their long-term medications, and to discover possible factors related to self-reported medication adherence.

1.1 Objective

This study aimed to investigate the extent of self-reported medication adherence and factors associated with self-reported medication adherence among people aged ≥ 75 years who are admitted to hospital from home.

2 Method

This descriptive study is based on data from an ongoing randomized controlled study (main study) [17]. The Medication Adherence Report Scale (MARS-5) questionnaire is applied during the admission period (baseline), then 30 days and 180 days after discharge from hospital. In the present study, we investigated patients' self-reported medical adherence according to MARS-5 at baseline.

2.1 Study Population and Settings

The main study is a randomized controlled trial with two parallel arms (intervention vs conventional care) [17]. The primary objective is to assess whether intervention by a clinical pharmacist during a transition of care can reduce the risk of unplanned drug-related hospital readmission for 180 days after the person leaves the hospital. The aim of the intervention is to discover and manage drug-related problems. The intervention is initiated within a week of the person being discharged from hospital, and includes repeated medical chart reviews, phone interviews, and in some cases medication reviews. The inclusion criteria were (i) ≥ 75 years of age, (ii) admitted acutely to the internal medicine or orthopedic department at Umeå University Hospital, Sweden, (iii) living at home (i.e., not in a nursing home), and (iv) registered at one of nine specified primary care centers. Persons were excluded if they did not speak Swedish or were unable to communicate, were admitted to hospital because of alcohol or drug intoxication, or were scheduled for palliative care. In the present study, subjects were retrospectively included if they fulfilled the above criteria, agreed to participate in the main study between September 2018 and September 2021, and used at least one medication before admission. Persons were excluded if they were not primarily responsible for their prescriptions or did not complete the MARS-5 questionnaire at baseline.

2.2 Procedures and Definitions

Persons admitted to the internal medicine or orthopedics department after entry at the emergency ward were scrutinized for eligibility one or two times per week. Persons who fulfilled the inclusion criteria were visited by clinical pharmacists during hospital admission to ask for participation in the main study. Persons who gave written informed consent were asked to assess their quality of life with EuroQuol Five-Dimension questionnaires and to respond to self-reported medical adherence with MARS-5. The pharmacist also asked the participants to respond to the four-item version of Gottfries' cognitive scale, a tool for proxy rating of cognitive impairment, which gives a dichotomous result of presence of cognitive impairment or not [18, 19]. The results from Gottfries' cognitive scale were used to sort participants into two subgroups, those with cognitive impairment (score 0–2) or not (score 3–4), in order to randomly assign them to one of the two study arms through a stratified randomization procedure. In the present study, participants were classified as cognitive impaired or not depending on their results on Gottfries' cognitive scale.

2.3 Self-Reported Medication Adherence

The MARS-5 questionnaire was applied to assess the self-reported medical adherence in this population, with a focus on the implementation phase. The implementation phase is the time after the patient initiates treatment to the point at which treatment is terminated [1]. MARS-5 is an established method that has been translated to Swedish and validated in various settings and populations [20–25]. MARS-5 consists of five statements: (i) "I forget to take my medications", (ii) "I alter the dose of my medications", (iii) "I stop taking my medications for a while", (iv) "I decide to skip a dose", and (v) "I take less than instructed" [21, 26]. Each question has

five Likert scale answers (1 = always, 2 = often, 3 = sometimes, 4 = rarely, and 5 = never). The final overall score ranged from 5 to 25 points, where a higher score represents better adherence [21]. In the present study, patients with scores of 23–25 were defined as adherent, while patients with scores of 5–22 were defined as nonadherent. A similar cut-off to define adherence assessed with MARS-5 has been used in several previous studies [22, 27–31].

2.4 Statistical Analysis

Continuous variables were reported as mean and standard deviations (SDs), while categorical variables were described as frequencies with percentages. To analyze group differences in baseline characteristics, the Student's *t*-test was applied for continuous variables and Pearson's χ^2 test was used for categorical variables. Fisher's exact test was applied for categorical variables with small sample sizes. Histograms were used to examine normal distribution. MARS-5 total score was reported as mean and SD. A reliability analysis was performed to analyze Cronbach's alpha of the MARS-5 scale. Significance of association between self-reported medication adherence according to MARS-5 and various variables were evaluated by multivariable logistic regression. MARS-5 was used as a dependent variable (adherent/nonadherent). Independent variables were included based on the hypotheses that they could be associated with self-reported adherence. The independent variables were age, sex, living status, use of dose-dispensed medications (prefilled medication bags), number of medications, comorbid conditions (depression, hypertension, heart failure, diabetes mellitus, myocardial infarction, atrial fibrillation, stroke, cancer, chronic obstructive pulmonary disease, and ischemic heart disease), and the presence of cognitive impairment as assessed by the four-item version of Gottfries' cognitive scale. All covariates were included in the analysis simultaneously. *P*-values <0.05 were considered statistically significant. All statistical calculations were performed using IBM SPSS Version 26.

3 Results

In total, 300 individuals admitted to the internal medicine or orthopedic department at a university hospital were screened for eligibility. All used at least one medication before admission, 31 individuals were excluded because they had home healthcare, and eight individuals did not have a fully completed MARS-5 questionnaire, which left 261 individuals who fulfilled all criteria and were included.

Table 1 show the characteristics of the participants. The mean age was 84.0 years (SD 5.7), the majority were women (64.4%), 60.2% lived alone, and 20.7% used dose-dispensed medications. The average number of medications prescribed per patient was 7.9 (SD 3.8). The most common chronic diseases were hypertension (72.8%), atrial fibrillation (40.2%), and heart failure (37.5%).

The mean MARS-5 score was 23.9 (SD 1.8), range 8–25, with a distribution towards high scores with 46.0% scoring 25. The Cronbach's alpha of the MARS-5 scale was 0.722. The MARS-5 results are presented in Table 2.

Among the 261 participants, 227 (87.0%) were classified as adherent to their prescribed treatment according to their results on MARS-5 (MARS-5 ≥23), while 34 (13.0%) participants were classified as nonadherent. As shown in Table 1, the groups were comparable at baseline, except that nonadherent participants were more likely to have cognitive impairment ($p = 0.035$) and depression ($p = 0.023$).

The multivariable logistic regression analysis showed that patients with cognitive impairment had a 0.4 lower odds (odds ratio = 0.40, 95% confidence interval 0.18–0.90, $p = 0.027$) to adhere to their long-term medications than patients without cognitive impairment (Table 3). Depression was associated with a 0.29 lower odds (odds ratio = 0.29, 95% confidence interval 0.10–0.87, $p = 0.028$) of being adherent compared with people without depression. No significant associations were shown between self-reported medication adherence and age ($p = 0.833$), female sex ($p = 0.243$), living status ($p = 0.726$), use of dose-dispensed medications ($p = 0.906$), number of medications used ($p = 0.554$), or with other chronic diseases adjusted for in the analysis (Table 3).

4 Discussion

In this study, most people aged 75 years and older rated themselves as adherent to their prescribed treatment, with 87% classified as adherent to their medications as assessed with MARS-5. After adjusting for various factors, only cognitive impairment and depression were independently associated with self-reported medication adherence according to MARS-5 in this population.

The adherence level in the present study is in line with results shown in previous studies using MARS-5 to study the implementation phase [28, 29, 31–33]. These studies focused on geriatric individuals and/or subjects with ischemic stroke or inflammatory bowel disease who were living at home. The reported adherence level often varies with the population studied, the time at which the assessment is performed, or which methods are used to assess adherence [9, 34–37]. As has been shown in previous studies, the repartition of MARS-5 answers was skewed [28, 29, 31, 33], suggesting that a recall bias or response bias cannot be ruled out.

Table 1 Baseline characteristics of the total population and a comparison of adherent versus nonadherent participants

	Total population $n = 261$	Adherent $n = 227$	Nonadherent $n = 34$	*P*-value
Patient characteristics				
Age, years, mean (SD)	84.0 (5.7)	84.1 (5.6)	83.8 (6.0)	0.776
Female sex, *n* (%)	168 (64.4)	148 (65.2)	20 (58.8)	0.469
Living alone, *n* (%)	157 (60.2)	136 (59.9)	21 (61.8)	0.837
Medications				
Number of medications, mean (SD)	7.9 (3.8)	8.0 (3.7)	7.9 (4.0)	0.887
Use of dose-dispensed medications, *n* (%)	54 (20.7)	47 (20.7)	7 (20.6)	0.988
Comorbidities, n (%)				
Cognitive impairment	82 (31.4)	66 (29.1)	16 (47.1)	**0.035**
Depression	24 (9.2)	17 (7.5)	7 (20.6)	**0.023**
Heart failure	98 (37.5)	89 (39.2)	9 (26.5)	0.153
Hypertension	190 (72.8)	162 (71.4)	28 (82.4)	0.179
Atrial fibrillation	105 (40.2)	93 (41.0)	12 (35.3)	0.529
Ischemic heart disease	93 (35.6)	93 (36.6)	10 (29.4)	0.417
Myocardial infarction, past	54 (20.7)	46 (20.3)	8 (23.5)	0.661
Diabetes mellitus	71 (27.2)	60 (26.4)	11 (32.4)	0.469
Stroke, past	49 (18.8)	43 (18.9)	6 (17.6)	0.857
COPD	36 (13.8)	32 (14.1)	4 (11.8)	1.000
Cancer, past or present	93 (35.6)	82 (36.1)	11 (32.4)	0.669

Bold *P*-values indicate statistically significant differences between the adherent and nonadherent groups

COPD chronic obstructive pulmonary disease, *SD* standard deviation

Table 2 Overview of MARS-5 scores and its individual items

MARS-5 questions	Mean ± SD	Always = 1, *n* (%)	Often = 2, *n* (%)	Sometimes = 3, *n* (%)	Rarely = 4, *n* (%)	Never = 5, *n* (%)
Item 1: "I forget to take my medicines"	4.5 ± 0.6	0 (0)	1 (0.4)	17 (6.5)	93 (35.6)	150 (57.5)
Item 2: "I alter the dose of my medicines"	4.8 ± 0.5	1 (0.4)	1 (0.4)	9 (3.4)	23 (8.8)	227 (87.0)
Item 3: "I stop taking my medicines for a while"	4.9 ± 0.4	1 (0.4)	0 (0)	6 (2.3)	14 (5.4)	240 (92.0)
Item 4: "I decide to skip a dose"	4.9 ± 0.5	1 (0.4)	0 (0)	6 (2.3)	21 (8.0)	233 (89.3)
Item 5: "I take less than instructed"	4.8 ± 0.5	1 (0.4)	2 (0.8)	5 (1.9)	25 (9.6)	228 (87.4)

MARS Medication Adherence Report Scale, *SD* standard deviation

The only significant associations between self-reported adherence and the included variables in the performed multivariable regression analysis were depression and cognitive impairment. Depression has been shown in meta-analyses to be associated with poorer adherence compared to non-depressed people [38, 39]. In addition to depression, previous studies on older people have found various factors related to self-reported adherence, for example, polypharmacy, younger age, male sex, perceived medication regimen as being complicated, handling problems, perceived side effects, costs, large caregiver burden, impaired hearing, beliefs about medications, and concerns about the medication [6, 9, 14, 33, 40, 41]. In addition to different settings and populations being studied, some of these studies combine different methods for assessing medication adherence, while others apply one method, as in the present study. It has been suggested that a combination of different methods to assess medication adherence may give more accurate results [42]. For example, in Norberg et al., self-reported adherence with MARS-5 was compared with more objective pharmacy refill adherence based on data from the Swedish Prescribed Drug Register, showing that 20% of the participants who were adherent according to MARS-5 were nonadherent according to the Swedish Prescribed Drug Register [33]. This study also showed that women had a higher odds of being classified as adherent than men as assessed with MARS-5, while men and younger age were associated with a higher odds of being adherent when assessed with the Swedish Prescribed

Table 3 Adjusted ORs of self-reported medication adherence as assessed with MARS-5

	Adjusted OR (95% CI)[a]	*P*-value
Patient characteristics		
Age, years	0.991 (0.914–1.075)	0.833
Female sex	1.638 (0.716–3.748)	0.243
Living alone	0.855 (0.357–2.050)	0.726
Medications		
Number of medications	1.037 (0.920–1.168)	0.554
Use of dose-dispensed medications	1.069 (0.350–3.270)	0.906
Comorbidities		
Cognitive impairment	**0.404 (0.181–0.903)**	**0.027**
Depression	**0.291 (0.097–0.873)**	**0.028**
Heart failure	1.700 (0.677–4.268)	0.259
Hypertension	0.472 (0.168–1.332)	0.156
Atrial fibrillation	1.123 (0.467–2.701)	0.795
Ischemic heart disease	2.722 (0.575–12.876)	0.207
Myocardial infarction, past	0.311 (0.058–1.671)	0.173
Diabetes mellitus	0.824 (0.351–1.937)	0.658
Stroke, past	0.899 (0.309–2.618)	0.845
COPD	0.986 (0.292–3.331)	0.981
Cancer, past or present	1.019 (0.442–2.346)	0.965

CI confidence interval, *COPD* chronic obstructive pulmonary disease, *MARS* Medication Adherence Report Scale, *OR* odds ratio

[a]Adjusted ORs by multivariable logistic regression analysis adjusted for all other variables (values of $p < 0.05$ shown in bold text)

Drug Register. The results of the present study indicate that our sample does not have the power to show statistically significant relationships. Future studies would preferably combine self-reported measures with more objective measures.

We hypothesized that cognitive impairment would be a factor most likely to be significantly associated with adherence, as reported in several studies [13, 43–47]. An important aspect is that we used the four-item version of Gottfries' cognitive scale to assess the participants' cognitive states instead of using, for example, an established diagnosis of major neurocognitive disorder. The four-item version of Gottfries' cognitive scale has a sensitivity of 97.8 and a specificity of 92.5, as applied in this study, when allowing one incorrect answer out of four to be classified as cognitively intact [19]. In the present study, Gottfries' cognitive scale was applied when the participants were hospitalized and therefore in an acute stage of disease, and it is possible that some participants in the subgroup with cognitive impairment may have received a worse rating at this time than they would have received if they had taken the test in their home environments, at a time when they were in stable health and not affected by pain or other concerns regarding the current admission.

In a review of systematic reviews, Kardas et al. showed that a vast number of determinants are probably involved in the medication adherence process [16]. The present study only included a few factors, and these are not enough to explain the complexity of adherence. Nevertheless, our results are by-and-large in line with the published literature and can contribute with an updated picture of how older people, living at home and admitted to hospital, perceive their own adherence.

The present study has several limitations. First, the study had a limited number of participants and only individuals aged ≥ 75 years were included, which reduces the study's generalizability. Second, MARS-5, the only tool used to evaluate self-reported medication adherence, may not be enough to provide an accurate picture of all aspects of the participants' adherence. A combination of various assessment methods may be more accurate for assessing medication adherence. Third, we cannot rule out that recall bias and response bias were present when participants answered the MARS-5 questionnaire. Recall bias might especially be a problem for participants who were classified with cognitive impairment as assessed with the Gottfries' cognitive scale; even so, it was important to include these participants in order to take account of the perceptions of this subgroup. Fourth, the participants were asked to answer the MARS-5 questionnaire with regard to their total medication list, not specific medications. In this study, an assumption was made that the participants were equally adherent to all their medications during implementation; however, adherence can differ between different long-term medications in some individuals [48]. Fifth, we had no data regarding the degree of depression in diagnosed individuals, which has been found to be positively correlated with poorer medication adherence [49]. Sixth, the study included only a limited number of factors that may be associated with medication adherence.

5 Conclusions

Among individuals aged ≥ 75 years who are admitted to hospital, the majority rated themselves as adherent to their prescribed medications as assessed with MARS-5. Future studies would benefit from adding more possible explanatory factors and to combine a more objective measurement of medication adherence in addition to a self-reported assessment.

Declarations

Funding This study was supported by grants from Region Västerbotten, the Swedish Society of Medicine, Umeå University Foundation for Medical Research, Forte (ref: 2017-01438), and the Swedish Research Council (ref: 2019-01078).

Conflicts of Interest The authors have no relevant financial or non-financial interests to disclose.

Ethics Approval The study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Regional Ethical Review Board in Umeå (registration no. 2017-69-31M, date: 7 March, 2017; registration no. 2018-83-32M, date: 9 March, 2018).

Consent to Participate Written informed consent was obtained from all participants. Individuals with major neuro-cognitive disorders participated without formal written informed consent, in which case both the participant and the next of kin were informed about the study and given the opportunity to decline participation. This process is in accordance with the Ethical Review Law in Sweden, which permits research involving persons with cognitive impairment under certain conditions, even if they cannot give fully informed consent.

Availability of Data and Material The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Code Availability Not applicable.

Authors' Contributions SI, MG, and HN contributed to the study conception and design. Material preparation, data collection, and analyses were performed by SI and HN. The first draft of the manuscript was written by SI. All authors critically revised the manuscript, provided final approval, and agree to be accountable for all aspects of the work.

References

1. Vrijens B, De Geest S, Hughes DA, Przemyslaw K, Demonceau J, Ruppar T, et al. A new taxonomy for describing and defining adherence to medications. Br J Clin Pharmacol. 2012;73(5):691–705.
2. Iuga AO, McGuire MJ. Adherence and health care costs. Risk Manag Healthc Policy. 2014;7:35–44.
3. Cutler RL, Fernandez-Llimos F, Frommer M, Benrimoj C, Garcia-Cardenas V. Economic impact of medication non-adherence by disease groups: a systematic review. BMJ Open. 2018;8(1): e016982.
4. Walsh CA, Cahir C, Tecklenborg S, Byrne C, Culbertson MA, Bennett KE. The association between medication non-adherence and adverse health outcomes in ageing populations: a systematic review and meta-analysis. Br J Clin Pharmacol. 2019;85(11):2464–78.
5. van Eijken M, Tsang S, Wensing M, de Smet PA, Grol RP. Interventions to improve medication compliance in older patients living in the community: a systematic review of the literature. Drugs Aging. 2003;20(3):229–40.
6. Cárdenas-Valladolid J, Martín-Madrazo C, Salinero-Fort MA, Carrillo Santa Pau E, Abánades-Herranz JC, de Burgos-Lunar C. Prevalence of adherence to treatment in homebound elderly people in primary health care: a descriptive, cross-sectional, multicentre study. Drugs Aging. 2010;27(8):641–51.
7. Berry SD, Quach L, Procter-Gray E, Kiel DP, Li W, Samelson EJ, et al. Poor adherence to medications may be associated with falls. J Gerontol A Biol Sci Med Sci. 2010;65(5):553–8.
8. Borah B, Sacco P, Zarotsky V. Predictors of adherence among Alzheimer's disease patients receiving oral therapy. Curr Med Res Opin. 2010;26(8):1957–65.
9. Uchmanowicz B, Jankowska EA, Uchmanowicz I, Morisky DE. Self-reported medication adherence measured with Morisky Medication Adherence Scales and its determinants in hypertensive patients aged ≥60 years: a systematic review and meta-analysis. Front Pharmacol. 2019;10:168.
10. Yap AF, Thirumoorthy T, Kwan YH. Systematic review of the barriers affecting medication adherence in older adults. Geriatr Gerontol Int. 2016;16(10):1093–101.
11. World Health Organization. Adherence to long-term therapies: evidence for action. Geneva: World Health Organizatoin; 2003.
12. Steinman MA, Hanlon JT. Managing medications in clinically complex elders: "There's got to be a happy medium." JAMA. 2010;304(14):1592–601.
13. Leung DY, Bai X, Leung AY, Liu BC, Chi I. Prevalence of medication adherence and its associated factors among community-dwelling Chinese older adults in Hong Kong. Geriatr Gerontol Int. 2015;15(6):789–96.
14. Campbell NL, Zhan J, Tu W, Weber Z, Ambeuhl R, McKay C, et al. Self-reported medication adherence barriers among ambulatory older adults with mild cognitive impairment. Pharmacotherapy. 2016;36(2):196–202.
15. Menditto E, Guerriero F, Orlando V, Crola C, Di Somma C, Illario M, et al. Self-assessment of adherence to medication: a case study in Campania region community-dwelling population. J Aging Res. 2015;2015: 682503.
16. Kardas P, Lewek P, Matyjaszczyk M. Determinants of patient adherence: a review of systematic reviews. Front Pharmacol. 2013;4:91.
17. Kindstedt J, Svahn S, Sjölander M, Glader EL, Lövheim H, Gustafsson M. Investigating the effect of clinical pharmacist intervention in transitions of care on drug-related hospital readmissions among the elderly: study protocol for a randomised controlled trial. BMJ Open. 2020;10(4): e036650.
18. Sandman PO, Adolfsson R, Norberg A, Nyström L, Winblad B. Long-term care of the elderly: a descriptive study of 3600 institutionalized patients in the county of Västerbotten. Sweden Compr Gerontol A. 1988;2(3):120–32.
19. Lövheim H, Gustafsson M, Isaksson U, Karlsson S, Sandman PO. Gottfries' cognitive scale for staff proxy rating of cognitive function among nursing home residents. J Alzheimers Dis. 2019;72(4):1251–60.
20. van de Steeg N, Sielk M, Pentzek M, Bakx C, Altiner A. Drug-adherence questionnaires not valid for patients taking blood-pressure-lowering drugs in a primary health care setting. J Eval Clin Pract. 2009;15(3):468–72.
21. Mahler C, Hermann K, Horne R, Ludt S, Haefeli WE, Szecsenyi J, et al. Assessing reported adherence to pharmacological treatment recommendations: translation and evaluation of the Medication Adherence Report Scale (MARS) in Germany. J Eval Clin Pract. 2010;16(3):574–9.
22. Bäck A, Sundell KA, Horne R, Landén M, Mårdby A-C. The Medication Adherence Report Scale (MARS-5) in a Swedish

sample with bipolar disorder: a pilot study. Int J Pers Cent Med. 2012;2(2):263–70.
23. Ladova K, Matoulkova P, Zadak Z, Macek K, Vyroubal P, Vlcek J, et al. Self-reported adherence by MARS-CZ reflects LDL cholesterol goal achievement among statin users: validation study in the Czech Republic. J Eval Clin Pract. 2014;20(5):671–7.
24. Tommelein E, Mehuys E, Van Tongelen I, Brusselle G, Boussery K. Accuracy of the medication adherence report scale (MARS-5) as a quantitative measure of adherence to inhalation medication in patients with COPD. Ann Pharmacother. 2014;48(5):589–95.
25. Lin CY, Ou HT, Nikoobakht M, Broström A, Årestedt K, Pakpour AH. Validation of the 5-item medication adherence report scale in older stroke patients in Iran. J Cardiovasc Nurs. 2018;33(6):536–43.
26. Chan AHY, Horne R, Hankins M, Chisari C. The Medication Adherence Report Scale: a measurement tool for eliciting patients' reports of nonadherence. Br J Clin Pharmacol. 2020;86(7):1281–8.
27. Mårdby AC, Akerlind I, Jörgensen T. Beliefs about medicines and self-reported adherence among pharmacy clients. Patient Educ Couns. 2007;69(1–3):158–64.
28. Sjölander M, Eriksson M, Glader EL. The association between patients' beliefs about medicines and adherence to drug treatment after stroke: a cross-sectional questionnaire survey. BMJ Open. 2013;3(9): e003551.
29. Norberg S, Gustafsson M. Older peoples' adherence and awareness of changes in drug therapy after discharge from hospital. Pharmacy (Basel). 2018;6(2):38.
30. Koppen IJN, van Wassenaer EA, Barendsen RW, Brand PL, Benninga MA. Adherence to polyethylene glycol treatment in children with functional constipation is associated with parental iIlness perceptions, satisfaction with treatment, and perceived treatment convenience. J Pediatr. 2018;199:132-9.e1.
31. Stone JK, Shafer LA, Graff LA, Lix L, Witges K, Targownik LE, et al. Utility of the MARS-5 in assessing medication adherence in IBD. Inflamm Bowel Dis. 2021;27(3):317–24.
32. Punnapurath S, Vijayakumar P, Platty PL, Krishna S, Thomas T. A study of medication compliance in geriatric patients with chronic illness. J Family Med Prim Care. 2021;10(4):1644–8.
33. Norberg H, Sjölander M, Glader EL, Gustafsson M. Self-reported medication adherence and pharmacy refill adherence among persons with ischemic stroke: a cross-sectional study. Eur J Clin Pharmacol. 2022;78(5):869–77.
34. Chung PW, Yoon BW, Lee YB, Shin BS, Kim HY, Park JH, et al. Medication adherence of statin users after acute ischemic stroke. Eur Neurol. 2018;80(1–2):106–14.
35. Yao X, Shah ND, Gersh BJ, Lopez-Jimenez F, Noseworthy PA. Assessment of trends in statin therapy for secondary prevention of atherosclerotic cardiovascular disease in US adults from 2007 to 2016. JAMA Netw Open. 2020;3(11): e2025505.
36. Wawruch M, Zatko D, Wimmer G Jr, Luha J, Hricak V Jr, Murin J, et al. Patient-related characteristics associated with non-persistence with statin therapy in elderly patients following an ischemic stroke. Pharmacoepidemiol Drug Saf. 2017;26(2):201–7.
37. Naderi SH, Bestwick JP, Wald DS. Adherence to drugs that prevent cardiovascular disease: meta-analysis on 376,162 patients. Am J Med. 2012;125(9):882-7.e1.
38. DiMatteo MR, Lepper HS, Croghan TW. Depression is a risk factor for noncompliance with medical treatment: meta-analysis of the effects of anxiety and depression on patient adherence. Arch Intern Med. 2000;160(14):2101–7.
39. Grenard JL, Munjas BA, Adams JL, Suttorp M, Maglione M, McGlynn EA, et al. Depression and medication adherence in the treatment of chronic diseases in the United States: a meta-analysis. J Gen Intern Med. 2011;26(10):1175–82.
40. Chew SM, Lee JH, Lim SF, Liew MJ, Xu Y, Towle RM. Prevalence and predictors of medication non-adherence among older community-dwelling people with chronic disease in Singapore. J Adv Nurs. 2021;77(10):4069–80.
41. Félix IB, Henriques A. Medication adherence and related determinants in older people with multimorbidity: a cross-sectional study. Nurs Forum. 2021;56(4):834–43.
42. Giardini A, Martin MT, Cahir C, Lehane E, Menditto E, Strano M, et al. Toward appropriate criteria in medication adherence assessment in older persons: position paper. Aging Clin Exp Res. 2016;28(3):371–81.
43. Hawkins LA, Kilian S, Firek A, Kashner TM, Firek CJ, Silvet H. Cognitive impairment and medication adherence in outpatients with heart failure. Heart Lung. 2012;41(6):572–82.
44. Stoehr GP, Lu SY, Lavery L, Bilt JV, Saxton JA, Chang CC, et al. Factors associated with adherence to medication regimens in older primary care patients: the Steel Valley Seniors Survey. Am J Geriatr Pharmacother. 2008;6(5):255–63.
45. Vinyoles E, De la Figuera M, Gonzalez-Segura D. Cognitive function and blood pressure control in hypertensive patients over 60 years of age: COGNIPRES study. Curr Med Res Opin. 2008;24(12):3331–9.
46. Smith D, Lovell J, Weller C, Kennedy B, Winbolt M, Young C, et al. A systematic review of medication non-adherence in persons with dementia or cognitive impairment. PLoS ONE. 2017;12(2): e0170651.
47. El-Saifi N, Moyle W, Jones C, Tuffaha H. Medication adherence in older patients with dementia: a systematic literature review. J Pharm Pract. 2018;31(3):322–34.
48. Steiner JF. Rethinking adherence. Ann Intern Med. 2012;157(8):580–5.
49. Liu Q, Wang H, Liu A, Jiang C, Li W, Ma H, et al. Adherence to prescribed antihypertensive medication among patients with depression in the United States. BMC Psychiatry. 2022;22(1):764.