Associations between personality traits and adequate home storage of drugs in older patients

Vlieland, N. D.; van den Bemt, B. J. F.; Wouters, H.; Egberts, A. C. G.; Bouvy, Marcel; Gardarsdottir, H.

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Link to publication in University of Groningen/UMCG research database

Taylor & Francis
Taylor & Francis Group

Check for updates

Associations between personality traits and adequate home storage of drugs in older patients

N.D. Vlieland[a], B.J.F. van den Bemt[b,c,d], H. Wouters[e], A.C.G. Egberts[a,f], Marcel Bouvy [iD][f] and H. Gardarsdottir[a,f,g]

[a]Department of Clinical Pharmacy, Division Laboratory and Pharmacy, University Medical Center Utrecht, Utrecht, The Netherlands; [b]Department of Pharmacy, Sint Maartenskliniek, Nijmegen, The Netherlands; [c]Department of Pharmacy, Radboud Medical Center, Nijmegen, The Netherlands; [d]Department of Clinical Pharmacy and Toxicology, Maastricht University Medical Center, Maastricht, The Netherlands; [e]Department of General Practice and Elderly Care Medicine, University of Groningen, University Medical Center Groningen, Groningen, The Netherlands; [f]Division of Pharmacoepidemiology and Clinical Pharmacology, Utrecht Institute for Pharmaceutical Sciences, Utrecht University, Utrecht, The Netherlands; [g]Faculty of Pharmaceutical Sciences, University of Iceland, Reykjavik, Iceland

ABSTRACT

The objective of this study was to investigate the association between personality traits of older patients and adequate home storage of drugs. Forty-four participating Dutch community pharmacists randomly selected each up to four community-dwelling elderly patients (≥65 years) who were using at least one prescription drug. The Big Five Inventory was used to assess the personality traits – 'openness', 'conscientiousness', 'extraversion', 'agreeableness' and 'neuroticism' – of patients. An assessment of adequate home storage of drugs was made using a summed composite score for each patient ranging from zero (adequate storage) to three (inadequate storage) was based on storage criteria representing quality, information and level of storage organization. A 51.2% of the patients stored drugs adequately in accordance with all quality ("Q") and information ("I") criteria. A high level of drug storage organization was found in 70.8% of patients. Forty-three patients (31.4%) stored their drugs adequately based on all storage criteria (composite storage score 0). No associations between personality dimensions and adequate drug storage were found. Having a lower number of drugs was associated with adequate drug home storage ($OR_{adjusted}$ 0.86; 95% CI: 0.77–0.96). In conclusion, this study suggests that personality is not associated with adequate home storage of drugs in older patients.

1. Introduction

Inadequate drug storage by patients is an important problem. To facilitate adequate storage, patients are recommended to store drugs according to the storage label statement provided in the drug information leaflet. Besides compliance with recommended storage conditions, patients should dispose drugs that have passed the expiry date and have access to relevant drug usage instructions (e.g. in the package insert or information leaflet) (Vlieland et al., 2018).

CONTACT H. Gardarsdottir ✉ H.Gardarsdottir@umcutrecht.nl 🖃 Department of Clinical Pharmacy, Division Laboratory and Pharmacy, University Medical Center Utrecht, Heidelberglaan 100, Utrecht 3584 CX, The Netherlands

However, inadequate drug storage is common (Wieczorkiewicz, Kassamali, & Danziger, 2013). Especially older patients are susceptible to inadequate drug storage at home. Polypharmacy, or the coincident prescribing of >5 drugs, is a prevalent condition in older patients of whom may have co-morbidities that are treated with multiple drugs. Different drugs tend to be prescribed in different doses, quantities and regimens (Gallagher, Barry, & O'Mahony, 2007). Adequate medication management and drug storage can therefore be challenging for older patients. Evidence indeed shows that older people lack the necessary knowledge and capacity to independently manage their drugs (Sino, Sietzema, Egberts, & Schuurmans, 2014). Consistent with this observation are findings from several observational studies showing that a considerable number of patients do not store drugs according to the drug product label statement (De Bolle et al., 2008; Sorensen, Stokes, Purdie, Woodward, & Roberts, 2006).

Inadequate storage can affect the quality of the medication (Benvenga, 2014; Vlieland et al., 2018). Specifically, it might compromise the drug's efficacy and may increase its toxicity. Acetylsalicylic acid, for example, is sensitive to moisture, leading to breakdown of acetylsalicylic acid into salicylic acid and acetic acid (Neuberger, Jooss, Ressel, & Neususs, 2016). Reasons why older patients do not store drugs according to the drug label statement are largely unknown. Although external factors can complicate drug storage, patient-related factors, such as personality traits, may also be important determinants of adequate drug storage by patients. Personality determines for a great deal patients' health behavior (Costa & McCrae, 1987), and may therefore also be relevant to understand individual differences between patients with regard to the adequacy by which they store their drugs. In the field of health psychology, the five-factor model has become the dominant model that has been adopted by researchers to study personality (Hampson et al., 2016). This model describes individual differences between people based on the personality traits of 'extraversion', 'neuroticism', 'conscientiousness', 'agreeableness' and 'openness to experience' (Costa & McCrae, 1987; McCrae & Costa, 1987).

Previously, several relationships were investigated between personality traits, medication adherence and related behaviors (Wouters et al., 2016), which are all behaviors related to drug storage. The personality trait 'conscientiousness' was found to be associated with better drug adherence for cholesterol-lowering treatment (Stilley, Sereika, Muldoon, Ryan, & Dunbar-Jacob, 2004) and asthma drugs (Axelsson et al., 2009). Furthermore, 'agreeableness' was found to be associated with attending clinic-based rehabilitation activities (Hilliard, Brewer, Cornelius, & Van Raalte, 2014) and better adherence to antibiotics (Axelsson, 2013).

In line with this previous research, the aim of this study was to investigate associations between personality traits and adequate home storage of drugs by older patients.

2. Methods

2.1. Setting and study population

A cross-sectional study was conducted between October 2015 and March 2016. Forty-four Dutch pharmacists enrolled in a postgraduate community pharmacy training program participated in the study. Each pharmacist received protocol training and selected up to four home-dwelling patients aged ≥65 years who used at least one prescription drug. Eligible patients were invited to participate by telephone or face-to-face at the pharmacy.

After receiving written and oral information, patients that gave written informed consent were included in the study.

2.2. Ethics

The Medical Ethics Review Committee of the University Medical Center Utrecht (protocol reference number 15–587/C) judged that the Medical Research Involving Human Subjects Act (WMO) was not applicable to this study; therefore, ethical approval was not required. The study protocol was also approved by the institutional review board (IRB) of the department of pharmaceutical sciences of the Utrecht University. Patients were informed and signed an informed consent prior to participation according to Dutch law. Confidentiality of participants was ensured using anonymized patient codes.

2.3. Study procedure

Pharmacists visited each patient twice in their homes. At the first visit, pharmacists used a structured drug inventory made to assess home storage of drugs. Patients were asked to present all prescription drugs that they were currently using (both chronic and as needed) and to show all home storage locations of prescription drugs. The following characteristics were collected for each drug at each storage location on the drug information form: drug identifiability, packaging type (primary and/or secondary) and condition (intactness), presence of drug product information leaflet (yes/no) and the expiry date (month/year). In addition, a small temperature logger ("Confrerie Clinique, SafeRx," 2014) was placed at each drug storage location to measure temperatures, and patients were asked to complete a questionnaire including questions on family situation, educational level and a personality assessment using the Big Five Inventory (BFI; section 3.5).

Pharmacists took pictures of and assessed every storage location for possible exposure to light or moisture. If a drug was stored at more than one location, each drug was separately assessed for adequate storage. During the second visit at least one week after the first assessment, pharmacists collected the temperature loggers and the completed personality assessment. Date and time of placement and collection of the temperature loggers were registered by the visiting pharmacist.

2.4. Study outcomes

The main study outcome consisted of three aspects of the patient's home storage of drugs: storage criteria representing drug quality based on three criteria representing drug quality ('Q'; section 3.4.1.), storage criteria representing drug information ('I'; section 3.4.2.) and the level of drug storage organization ('O'; section 3.4.3) (Vlieland et al., 2018). A composite score for each patient based on these three aspects is described in section 3.4.4. In addition, patients were asked about their reasons ('storage advice', 'part of a daily/weekly routine', 'as a reminder') to store drugs on a particular location.

2.4.1. Criteria representing drug quality

The quality criteria were assessed for each drug and consisted of the following items: ('Q1') drug storage conditions according to label storage statement for temperature, light, humidity; ("Q2") the drug's expiry date; ("Q3") the drug's primary package integrity (Table 1). Patients

Table 1. Storage drug quality ('Q') and information ('I') criteria for drug storage assessment.

Storage criteria	Patient were considered to store drugs adequately when ...
'Q1' – storage conditions	... storage temperature for all drugs did not exceed the advised storage temperature range as indicated in the drug information leaflet for at least two hours and were not stored in a humid place or exposed to light when applicable.
'Q2' – expiry date	... the expiry dates of all drugs had not passed on the day of the first visit
'Q3' – primary package integrity	... all of the drugs' primary packages were intact.
'I1' – drug identifiability	... all drug were identifiable (name, strength) by their primary or secondary packaging
'I2' – drug information leaflet	... at least one drug information leaflet could be presented for each drug.

were considered to store drugs adequately according to the first quality criterion ("Q1") when storage temperatures for all drugs did not exceed the advised storage temperature range as indicated in the drug information leaflet (data extracted from the Dutch G Standard database containing all drug products) ("G standaard," 2015) for at least 2 h and were not stored in a humid place or exposed to light when applicable. Drugs not requiring refrigeration were considered to require storage at room temperature defined as temperature below 25°C without excursions above 25°C for 2 h or longer. Refrigerator storage was considered adequate if the temperature was between 2°C and 8°C, without excursions outside this range for 2 h or longer, except when storage outside the refrigerator was allowed for drugs in use (e.g. insulin). For drugs that explicitly require no exposure to light or moisture humidity and light exposure, at each storage location, was assessed by the pharmacist and defined as adequate or inadequate. Patients were considered to store drugs adequately according to the second criterion ("Q2") when the expiry dates of all drugs had not passed on the day of the first visit. The drugs' primary package integrity ("Q3") was based on the intactness of the primary package (e.g. damaged blister package no longer protective against moisture); patients were considered to store drugs adequately when all of the drugs' primary packages were intact.

2.4.2. Criteria representing drug information availability

The drug information criteria consisted of the following items: the drug's identifiability ("I1") and the information leaflet availability ("I2") (Table 1). Patients were considered to store drugs adequately when drugs were identifiable (name, strength) by their primary or secondary packaging. Drug storage in a multi-dose dispensing (MDD) system was considered adequate. With regard to the second criterion, patients were considered to store drugs adequately when patients could present at least one drug information leaflet for each drug.

2.4.3. Criteria representing drug storage organization

Drug storage organization ('O') was categorized into three organizational levels: high level, intermediate level and low level. Our scale was inspired by scales measuring disorganization and cluttering in households, such as the Clutter-Hoarding Scale (ICD, 2011), but with the primary focus on drug storage locations. High level of drug storage organization was characterized by the extent package sorting, dedicated drug storage location, intact packages, clear identifiable drugs and neat and well-arranged drug storage locations. An intermediate level of drug storage organization showed partial package sorting, drugs stored with other household belongings and a combination of primary and secondary packages. The lowest

level of drug organization was characterized by no package sorting, combination of primary, secondary or no packages, cluttering, multiple storage locations (≥3), difficulties identifying drugs for the caregiver (e.g. possible risk of accidental mix-up, errors).

Pictures of storage locations for each patient were rated by five raters (BB, HG, MB, HW, NV). Raters were able to adjudicate pictures of patients as 'not assessable' if they were unable to assess the patients' storage locations (e.g. pictures were vague, zoomed). The final rating was decided based on the agreement of at least four raters. Disagreements were discussed by NV, HG and BB until consensus was reached.

2.4.4. Composite score representing drug quality, drug information availability and drug storage organization

A composite score for adequate storage for each patient was based on storage criteria representing quality (0: adequate; 1: inadequate based on "Q1", "Q2", and/or "Q3"), information (0: adequate; 1: inadequate based on "I1" and/or "I2") and level of storage organization (0: high level, 1: intermediate/low level). This score ranges from zero (adequate storage) to three (inadequate storage).

2.5. Personality traits

Patients were asked to fill out the Dutch version of the 44-item Big Five Inventory (Denissen, Geenen, van Aken, Gosling, & Potter, 2008). The BFI assesses the personality traits – 'openness', 'conscientiousness', 'extraversion', 'agreeableness' and 'neuroticism' – were assessed. 'Openness' refers to a persons' flexibility and their openness to new experiences. 'Extraversion' is characterized by positive emotions and being assertive as well as being energetic whereas 'Neuroticism' is characterized by a person's vulnerability to stress and difficulties controlling impulses and desires. 'Conscientiousness' refers to the level of organization and order. 'Agreeableness' refers to friendliness, being cooperative and accepting. Patients were asked to rate all 44 items (e.g. *I see myself as someone who does things efficiently'* and *'I see myself as someone who tends to be disorganized'*) of the BFI on 5-point Likert scales (1, strongly disagree; 5, strongly agree). The personality traits 'extraversion' (Cronbach α = 0.79), 'neuroticism' (Cronbach α = 0.78), 'openness' (Cronbach α = 0.77), 'conscientiousness' (Cronbach α = 0.79) and 'agreeableness' (Cronbach α = 0.75) all had sufficiently high internal consistencies. We subjected all BFI items to a factor analysis (varimax rotation) in order to examine whether BFI items measured the corresponding personality traits (McCrae & Costa, 1987). The factor loadings observed in the present study were consistent with those presented by Denissen et al. (Denissen et al., 2008). Missing values were imputed using multiple imputations (Azur, Stuart, Frangakis, & Leaf, 2011). Patients were excluded from the analysis if they omitted more than eight BFI items. For 18 patients (10.6%) no personality assessment could be made, either because patients did not return (4.5%) or returned an incomplete inventory (6.1%).

2.6. Covariates

Covariates included the patient characteristics: gender, age, family status (living alone vs. with a partner/others), educational level (low, medium, high), use of a multi-dose dispensing system and number of drugs stored.

2.7. Data analysis

Demographic data, drug quantities and drug storage quality criteria and information criteria were presented using means (standard deviation [SD]) in case of normal distributions or medians (interquartile range [IQR]) in case of non-parametric distributions or in proportions of the study population. Mean scores (SD, range) for the sum of each of the Big Five personality traits were calculated. Associations between the five patient personality traits of the BFI, patient characteristics (gender, age, education, household size, use of MDD system, number of drugs) and the composite score for adequate drug storage were investigated using an univariate and multivariate logistic regression analysis. A stepwise approach (forward selection), excluding variables (patient characteristics) with p > 0.1 in the univariate model, was used to build the final model. Results of the logistic regression models were presented as odds ratios with 95% confidence intervals. Patients were considered to store drugs adequately if the composite score was zero. A sensitivity analysis was performed where patients were allowed to violate one of the three storage criteria ('Q', 'I' or 'O') and still be considered to store their drugs adequately. Additionally, associations between adequate storage quality ('Q') and information ('I') and the level of home storage organization ('O') for drugs were assessed with a separate logistic regression model. Results were presented as odds ratios with 95% confidence intervals. The data was analyzed with the statistical software from SAS version 9.4 (SAS Institute, Cary, North Carolina, USA).

3. Results

A total of 137 patients (80.6%) were assessed on storage quality, information, the level of storage organization as well as their personality and were included in the study. Patients that were not included could not be assessed on the level of storage organization due to missing/ insufficient pictures (8.8%) or because they did not complete their personality assessment (10.6%). More than half of the patients included in the study were female (51.8%), the median age was 74 (IQR: 11) years and 33.6% of the patients were living alone. Most patients had a medium or high educational level (83.2%) (Table 2). The median number of prescription drugs stored was 5 (IQR: 5). One-third of the patients (33.6%) used a multi-dose dispensing system to store drugs. Patients' reasons for the use of specific storage locations were most commonly related to aspects of daily routine ('drug intake is part of a (daily) routine', 66.7%) or 'as a reminder to take the drug' (12.3%). A 7.1% of patients named 'storage advice' as a reason for storage location, primarily for drugs requiring refrigeration.

A 66.4% and 69.3% of the patients stored drugs adequately according to quality criteria ('Q') and information criteria ("I"), respectively. The individual storage criteria were as follows: 102 patients (74.5%) stored drugs adequately based on storage conditions ("Q1"), 123 patients (89.8%) did not store drugs that had already passed the expiry date ("Q2") and 129 patients (94.2%) stored drugs adequately by having the drug's primary package intact ("Q3"). For drug information criteria, 132 patients (96.4%) stored their drugs in an identifiable package ("I1") and 97 patients (70.8%) had the drug information leaflet ("I2") available for all drugs. Three patients (1.8%) inadequately stored drugs based on both drug information criteria ("I1-I2") and one patient stored drugs inadequately based on all drug quality criteria ("Q1-Q2-Q3"). Representative pictures of home storage locations for drugs are presented in Figure 1. Pictures of location from 79 patients (57.7%) were discussed until

Table 2. Baseline characteristics of the study population.

Characteristic	Patients (N = 137)
*Age**	74 (11)
*Number of drugs**	5 (5)
Sex	
Female	51.8%
Educational level$_a$	
Low	16.8%
Medium	54.7%
High	19.0%
Family type$_a$	
Living alone	33.6%
Living with others	65.0%
Use of MDD$_b$	
Yes	33.6%

* Median(IQR).
^{a}Numbers do not add up to 100% due to missing values.
^{b}MDD = multi-dose drug dispensing system.

Figure 1. Examples of storage locations showing different home storage organization levels of drugs. The left pane was rated as high-level storage organization, the middle pane as intermediate level storage organization and the right pane as low-level storage organization.

consensus was reached. The raters adjudicated 97 patients (70.8%) to a high level of home storage organization ('O') for drugs, 34 patients (24.8%) to the intermediate level of storage organization and 6 patients (4.4%) to the lowest level of storage organization.

The mean score of the BFI questionnaire for 'extraversion' in the study population was 27.8 (SD 5.0; range 11–38), for 'agreeableness' 34.6 (SD 4.5; range 18–43), for 'conscientiousness' 33.6 (SD 4.7; 16–45), for 'neuroticism' 21.7 (SD 4.8; range 9–39) and the mean score for 'openness' was 32.6 (SD 5.9; range 15–44).

Mean scores for each personality trait and the composite storage score are presented in Figure 2. Forty-three patients (31.4%) stored their drugs adequately based on all storage criteria (composite storage score 0). Fifty-four patients (39.4%), 30 patients (21.9%) and 10
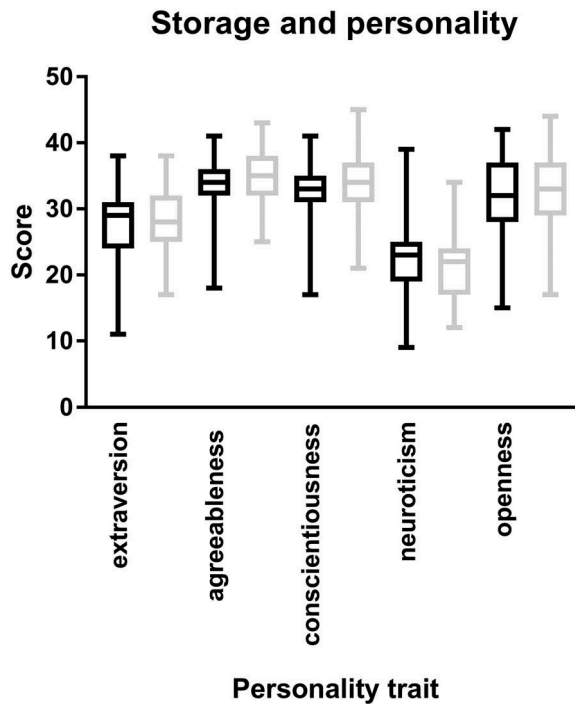
Storage and personality

Figure 2. Box plot presenting patient personality traits 'extraversion', 'agreeableness', 'conscientiousness', 'neuroticism', 'openness' and adequate (black) and inadequate (grey) home storage.

patients (7.3%) stored their drugs inadequately and counted, respectively, '1', '2' and '3' on the composite score. Personality traits 'extraversion', 'agreeableness', 'conscientiousness', 'neuroticism' and 'openness' were not associated with adequate storage. Having a lower number of drugs stored was associated with adequate storage ($OR_{adjusted}$ 0.86; 95% Confidence Interval: 0.77–0.96) (Table 3). The sensitivity analysis did not result in other significant associations. No associations were found between adequate storage quality ("Q") or storage information ("I") and the level of drug storage organization ('O').

4. Discussion

In this study in older patients, none of the personality traits, 'extraversion', 'agreeableness', 'conscientiousness', 'neuroticism' and 'openness' were associated with the adequate storage. One-third of older patients were considered to store drugs adequately. A lower number of drugs stored was associated with adequate home storage.

We did not find an association between the five personality traits in older patients and adequate home storage, therefore not supporting the hypothesis that patient's tendency to be punctual and organized ('conscientiousness') promotes adequate home storage. The number of total drugs stored in patients´ homes was lower compared to other studies, which might partly be explained by the assessment of only prescription drugs (Barat, Andreasen, & Damsgaard, 2000). The majority of patients had a high level of home storage organization for multiple drugs. The pictures confirmed patient's statements that behavior and daily routines played an important role in their reasons for choosing specific storage

Table 3. Associations between personality traits and adequate home storage conditions for drugs.

	Inadequate storage N = 94	Adequate storage N = 43	Crude OR (95% CI)	Adjusted OR (95% CI)
*Sex**				
Female	53 (56.4)	18 (41.9)	0.56 (0.27–1.16)	-
*Age***	73 (11)	76 (12)	1.02 (0.97–1.07)	-
*Family type**				
Missing	1 (1.1)	1 (2.3)	NA	-
Alone	32 (34.0)	14 (32.6)	Ref	-
With others	61 (64.9)	28 (65.1)	1.05 (0.49–2.27)	-
*Educational level**				
Missing	9 (9.6)	4 (9.3)	NA	-
Low	15 (16.0)	8 (18.6)	Ref	-
Medium	51 (54.3)	24 (55.8)	0.88 (0.33–2.36)	-
High	19 (20.2)	7 (16.3)	0.69 (0.20–2.34)	-
*Use of MDD**				
Yes	28 (29.8)	9 (20.9)	0.62 (0.27–1.47)	-
*Number of drugs ***	6.0 (6.0)	4.0 (4.0)	**0.78 (0.68–0.90)**	**0.86 (0.77–0.96)**
*Personality traits****				
Extraversion	27.9 (4.8)	27.5 (5.5)	0.99 (0.92–1.06)	1.06 (0.96–1.16)
Agreeableness	35.0 (4.0)	33.5 (4.6)	0.92 (0.85–1.01)	0.94 (0.84–1.04)
Conscientiousness	34.1 (4.3)	32.4 (4.9)	0.92 (0.85–1.00)	0.94 (0.85–1.05)
Neuroticism	21.2 (4.7)	22.6 (5.1)	1.06 (0.98–1.14)	1.05 (0.96–1.15)
Openness	32.8 (5.6)	32.0 (6.3)	0.98 (0.92–1.04)	(0.91–1.05)

* = n(%). ** = median (IQR). *** = mean (SD). - = not included in final model. IQR = Interquartile range. OR = Odds Ratio. CI = confidence interval. MDD = multidose drug-dispensing system.

locations in their home (e.g. near television or radio as a visual reminder). One-third of patients used multi-dose dispensing systems, which is higher than previously reported (Johnell & Fastbom, 2008; SFK, 2015), possibly due to the high proportion of patient over 75 years of age. We expected patients with the highest level of storage organization would be more likely to store their drugs adequately; however, this was not confirmed in our study. Patients did not mention the drug storage conditions on the product label as a reason for selecting a specific location for storage, except patients having drugs requiring refrigeration. This is consistent with the results of Sanders et al., who found that patients developed individualized behaviors for taking drugs and often adjust these to their daily routines (Sanders & van Oss, 2011). This fuels our understanding for patients' considerations of how and where to store drugs in their homes, suggesting inadequate storage by patients can be non-intentional. In their home setting, patients may not make a rational decision to facilitate adequate drug storage in their homes and can make a different trade-off (e.g. taking drugs out of the refrigerator in case of lack of space or keeping expired drugs for future 'as needed' use) that does not prioritize adequate drug storage.

Adequate storage is a facilitator for good drug use, preventing the use of expired drug products, clear recognition of drug products and thereby minimizing errors or mix-ups, and availability of important drug information in the information leaflet when needed. Improving the home storage of drugs requires health-care professionals to address its relevant determinants. Older patients storing a higher number of drugs store these less adequate. Pharmacists should pay extra attention to the importance of adequate home storage in older patients using multiple drugs, thereby improving home storage conditions, drug quality and facilitating the safe use of drugs. In addition to creating more awareness regarding adequate home storage by providing information about drug storage, interventions could promote better storage of

drugs. An intervention study aimed to promote adequate drug storage after hospital discharge in older patients showed that having domiciliary visits by the pharmacist can result in better home storage of drugs (Begley, Livingstone, Hodges, & Williamson, 1997). Especially those patients with multiple drugs stored in their homes could benefit from a domiciliary visit by the pharmacist or pharmacy technician with attention for and counseling on adequate drug storage. Our organization scale could be used as a tool to identify disorganization at storage locations for drugs.

The main strength of this study is the assessment of several aspects of home storage of drugs taking into account the quality of storage, information availability and level of storage organization. Older patients were recruited in 44 geographically dispersed pharmacies and home storage characteristics were assessed on site by a trained pharmacist. However, this study was also subject to some limitations. Patients were aware of the study purpose and might have already discarded unused or expired drugs and reorganized their household before the visit. This might have led to an underestimation of the number of patients and drugs that are not stored appropriately. We did not assess if patients were solely responsible for their drug home storage or if they received assistance from their caregiver or partner. Those who have already experienced difficulties with drug storage might have asked for (professional) help or used a multi-dose dispensing system. To limit variation in the amount of information per patient, pharmacists received protocol training and were required to use a standardized inventory list for each drug. No test to assess cognitive functioning was performed. Age-associated cognitive decline and incident mild cognitive impairment and dementia are common in older patients (Maddigan, Farris, Keating, Wiens, & Johnson, 2003), and patients with cognitive impairment may already have difficulties storing multiple drugs, possibly interfering with the relation between personality and adequate drug storage. Although the rating of storage locations provides valuable insight into how drugs are stored in patients' homes, its reliability and value need to be confirmed by other investigators. The limitations mentioned are all likely to increase the type II error rate.

5. Conclusion

This study suggests that personality is not associated with adequate home storage of drugs in older patients. The majority of patients mentioned daily routines and visual reminders as their main reason considering drug storage locations.

Disclosure statement

Funding

ORCID

Marcel Bouvy http://orcid.org/0000-0002-4596-0684

References

Axelsson, M. (2013). Report on personality and adherence to antibiotic therapy: A population-based study. *BMC Psychology*, *1*(1), 24. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/25566372

Axelsson, M., Emilsson, M., Brink, E., Lundgren, J., Toren, K., & Lotvall, J. (2009). Personality, adherence, asthma control and health-related quality of life in young adult asthmatics. *Respiratory Medicine*, *103*(7), 1033–1040. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/19217764

Azur, M. J., Stuart, E. A., Frangakis, C., & Leaf, P. J. (2011). Multiple imputation by chained equations: What is it and how does it work? *International Journal of Methods in Psychiatric Research*, *20*(1), 40–49. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/21499542

Barat, I., Andreasen, F., & Damsgaard, E. M. (2000). The consumption of drugs by 75-year-old individuals living in their own homes. *European Journal of Clinical Pharmacology*, *56*(6–7), 501–509. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/11049014

Begley, S., Livingstone, C., Hodges, N., & Williamson, V. (1997). Impact of domiciliary pharmacy visits on medication management in an elderly population. *International Journal of Pharmacy Practice*, *5*, 111–121.

Benvenga, S. (2014). Solution of a diagnostic problem upon visiting the patient at home and reading their medication leaflet. *Endocrine Practice*, *20*(5), 517. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/24816755

Confrerie Clinique, SafeRx. (2014). Retrieved from http://www.confrerie-clinique.com/products/tempos/.

Costa, P. T., Jr., & McCrae, R. R. (1987). Personality assessment in psychosomatic medicine. Value of a trait taxonomy. *Advances in Psychosomatic Medicine*, *17*, 71–82. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/3591565

De Bolle, L., Mehuys, E., Adriaens, E., Remon, J. P., Van Bortel, L., & Christiaens, T. (2008). Home medication cabinets and self-medication: A source of potential health threats? *The Annals of Pharmacotherapy*, *42*(4), 572–579. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/18364405

Denissen, J. J., Geenen, R., van Aken, M. A., Gosling, S. D., & Potter, J. (2008). Development and validation of a Dutch translation of the Big Five Inventory (BFI). *Journal of Personality Assessment*, *90*(2), 152–157. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/18444109

G standaard. (2015). Retrieved from https://www.z-index.nl/g-standaard.

Gallagher, P., Barry, P., & O'Mahony, D. (2007). Inappropriate prescribing in the elderly. *Journal of Clinical Pharmacy and Therapeutics*, *32*(2), 113–121. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/17381661

Hampson, S. E., Edmonds, G. W., Barckley, M., Goldberg, L. R., Dubanoski, J. P., & Hillier, T. A. (2016). A Big Five approach to self-regulation: Personality traits and health trajectories in the Hawaii longitudinal study of personality and health. *Psychology, Health & Medicine*, *21*(2), 152–162. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/26196294

Hilliard, R. C., Brewer, B. W., Cornelius, A. E., & Van Raalte, J. L. (2014). Big five personality characteristics and adherence to clinic-based rehabilitation activities after ACL Surgery: A prospective analysis. *Journal of Oral Rehabilitation*, *7*, 1–5. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/25663952

ICD. (2011). Institute for challenging disorganization: Clutter hoarding scale. Retrieved from http://www.challengingdisorganization.org/sites/default/files/ICD_CHS_FINAL_062911b.pdf.

Johnell, K., & Fastbom, J. (2008). Multi-dose drug dispensing and inappropriate drug use: A nationwide register-based study of over 700,000 elderly. *Scandinavian Journal of Primary Health Care*, *26*(2), 86–91. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/18570006

Maddigan, S. L., Farris, K. B., Keating, N., Wiens, C. A., & Johnson, J. A. (2003). Predictors of older adults' capacity for medication management in a self-medication program: A retrospective chart

review. *Journal of Aging and Health*, *15*(2), 332–352. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12795276

McCrae, R. R., & Costa, P. T., Jr. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of Personality and Social Psychology*, *52*(1), 81–90. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/3820081

Neuberger, S., Jooss, K., Ressel, C., & Neususs, C. (2016). Quantification of ascorbic acid and acetylsalicylic acid in effervescent tablets by CZE-UV and identification of related degradation products by heart-cut CZE-CZE-MS. *Analytical and Bioanalytical Chemistry*, *408*(30), 8701–8712. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/27405873

Sanders, M., & van Oss, T. (2011). Using daily routines to promote medication adherence in older adults. *The American Journal of Occupational Therapy*, *67*(1), 91–99.

SFK. (2015). Kwart 80-plussers gebruikt een weekdoseersysteem. Retrieved from https://www.sfk.nl/publicaties/PW/2015/kwart-80-plussers-gebruikt-een-weekdoseersysteem.

Sino, C. G., Sietzema, M., Egberts, T. C., & Schuurmans, M. J. (2014). Medication management capacity in relation to cognition and self-management skills in older people on polypharmacy. *The Journal of Nutrition, Health & Aging*, *18*(1), 44–49. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/24402388

Sorensen, L., Stokes, J. A., Purdie, D. M., Woodward, M., & Roberts, M. S. (2006). Medication management at home: Medication risk factor prevalence and inter-relationships. *Journal of Clinical Pharmacy and Therapeutics*, *31*(5), 485–491. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/16958827

Stilley, C. S., Sereika, S., Muldoon, M. F., Ryan, C. M., & Dunbar-Jacob, J. (2004). Psychological and cognitive function: Predictors of adherence with cholesterol lowering treatment. *Annals of Behavioral Medicine : a Publication of the Society of Behavioral Medicine*, *27*(2), 117–124. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/15026295

Vlieland, N. D., Nejadnik, M. R., Gardarsdottir, H., Romeijn, S., Sediq, A. S., Bouvy, M. L., . . . Jiskoot, W. (2018). The impact of inadequate temperature storage conditions on aggregate and particle formation in drugs containing tumor necrosis factor-alpha inhibitors. *Pharmaceutical Research*, *35*(2), 42. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/29404710

Vlieland, N. D., van Den Bemt, B. J. F., Bekker, C. L., Bouvy, M. L., Egberts, T. C. G., & Gardarsdottir, H. (2018). Older patients' compliance with drug storage recommendations. *Drugs & Aging*, *35*(3), 233–241. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/29423781

Wieczorkiewicz, S. M., Kassamali, Z., & Danziger, L. H. (2013). Behind closed doors: Medication storage and disposal in the home. *The Annals of Pharmacotherapy*, *47*(4), 482–489. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/23535813

Wouters, H., Amin, D. F., Taxis, K., Heerdink, E. R., Egberts, A. C., & Gardarsdottir, H. (2016). Associations between personality traits and adherence to antidepressants assessed through self-report, electronic monitoring, and pharmacy dispensing data: A pilot study. *Journal of Clinical Psychopharmacology*, *36*(5), 465–471. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/27454894