ORIGINAL RESEARCH

Relationship Between Polypharmacy and Geriatric Syndromes in Older Nursing Home Residents

Ⓘ Fatma Özge Kayhan Koçak, Ⓘ Emin Taşkıran, Ⓘ Sevnaz Şahin

Ege University Faculty of Medicine, Department of Internal Medicine, Division of Geriatrics, İzmir, Turkey

Objective: Our aim is to determine the prevalence of polypharmacy and the relationship between polypharmacy and geriatric syndromes as well as comorbidity in older nursing home residents (NHR).

Materials and Methods: This observational and cross-sectional study was conducted with 217 adults ≥ 60 years of age who had Katz Index of Independence in Activities of Daily Living score over 4 points and were institutionalized at Nursing Care Home from March to April 2019. Polypharmacy was defined as the daily use of 5 or more medications. Geriatric syndromes included dementia, depression, urinary incontinence (UI), malnutrition, falls, mobility problems, hearing loss, vision impairments.

Results: The prevalence of polypharmacy among NHR was 61.8%. By univariate analysis, polypharmacy was associated with chronic diseases such as heart disease, chronic obstructive pulmonary disease (COPD) and diabetes mellitus (DM), and with geriatric syndromes such as dementia, depression, UI, and mobility problems (p< 0.05). In the multivariate analyses, depression (odds ratio [OR] = 9.57; 95% CI, 2.73-33.60) and mobility problems (OR= 4.88; 95% CI, 1.80-13.25) increased polypharmacy by 9.6 and 4.9-fold respectively.

Conclusion: Comorbidity and geriatric syndromes play an important role in the development of polypharmacy. Monitoring polypharmacy is often necessary as well as giving complex medication regimens for NHR.

Keywords: Activities of Daily Living, Comorbidity, Geriatric Syndromes, Nursing Homes, Polypharmacy

Introduction

Polypharmacy is becoming increasingly prevalent in older adults each year, particularly in nursing home residents (NHR). Older adults without disabilities can easily access health services to prescribe medications. The lack of assessment of patient's prior medications by each specialist is the main reason for widespread polypharmacy among NHR. Consequently, the risk of polypharmacy increases along with an increased number of hospital admissions and comorbidities.

Polypharmacy does not have a generally accepted definition (1,2). Similarly, it was defined by the World Health Organization (WHO) as followed: "Polypharmacy is the concurrent use of multiple medications. Although there is no standard definition, polypharmacy is often defined as the routine use of five or more medications. This includes over-the-counter, prescription and/or traditional and complementary medicines used by a patient"(3).

The most common definition for polypharmacy is the use of five or more medications (1). According to this definition, the prevalence of polypharmacy ranged from 38.1% to 91.2% in NHR (2,4,5). Prevalence of polypharmacy varied based on numerical definitions of polypharmacy, dependence of NHR, age, and level of care (1).

Polypharmacy increases as the number of comorbidities increases (6). Polypharmacy was found to be associated with heart disease, functional decline, stroke, geriatric syndromes, including cognitive impairment, depression, poor nutrition, and falls (7–9). Polypharmacy in long-term care facilities was associated with comorbid conditions; circulatory diseases, digestive disorders, endocrine and metabolic disorders, genitourinary disorders musculoskeletal disabilities, neurological motor dysfunction, pulmonary diseases (5,10). As a result, polypharmacy was associated with number of hospitalizations, length of stay, emergency department admission and all-cause

Kayhan Koçak et al. Polypharmacy and Geriatric Syndromes

Eur J Geriatr Gerontol

hospitalization (2). Chang TI et al demonstrated an association between polypharmacy and mortality, regardless of chronic conditions (11).

Understanding the factors associated with polypharmacy is important to reduce negative outcomes of comorbidities. The relationship between polypharmacy and geriatric syndromes has been investigated generally in the community dwelling older outpatients in Turkey (12–17). In addition, researches in nursing homes usually focused on the association of polypharmacy with sarcopenia in Turkey (18,19). Based on this background, the aim of this study is to determine the prevalence of polypharmacy and the relationship between polypharmacy and geriatric syndromes as well as comorbidities in older NHR.

Materials and Methods

Study population

This observational and cross-sectional study was conducted with 217 adults, ≥60 years of age who were institutionalized at Nursing Care Home from March to April 2019. The NHRs who had Katz Index of Independence in Activities of Daily Living (KATZ-ADL) score below 5 points were excluded (20). No sampling was done because it was planned to include all eligible NHRs in this study.

Assessments

Data were collected using a structured questionnaire by researchers through face-to-face interviews with NHRs and the responsible nurses of them. Patients' data about number of chronic diseases and prescribed drugs; falls (in the last year); the presence of urinary incontinence (UI); visual impairment; hearing loss; walking disability (the use of a cane, crutches, walking frame); malnutrition; admission to the hospital in the last six months, were noted. Polypharmacy was defined as the daily use of 5 or more medications (1,21), and NHRs were separated into groups by polypharmacy status as non-polypharmacy and polypharmacy.

Geriatric Syndromes

Functional status

To evaluate functional status, KATZ ADL scale was used. KATZ ADL assesses six functions including dressing, feeding, going to toilet, continence, bathing and transferring. A score of 4 and below indicates functional impairment (20). The NHR who had Katz Index of Independence in Activities of Daily Living (KATZ-ADL) score below 5 points were excluded.

Dementia

Cognitive function of all NHRs is routinely assessed by clinical judgment annually and as needed; NHRs are referred to a neurologist as required. So, Participants with a diagnosis of dementia and taking anti-dementia drugs were assessed as having dementia.

Depression

The presence of depression is assessed by the 15 item Geriatric Depression Scale Short-Form in NHRs every six months; NHRs are referred to a psychiatrist as required. Participants with a diagnosis of depression and taking antidepressant treatment were assessed as having depression.

Falls

A fall was defined as "an unexpected event in which the participant comes to rest on the ground, floor, or lower level"(22). Falls history over the past 12 months has been noted.

Urinary incontinence

Urinary incontinence (UI) was defined as the unintentional passing of urine independent of amount. Participants taking medication for urinary incontinence were also included.

Visual impairment

Visual impairment was defined as wearing glasses or a decreased ability to see. We assessed visual impairment by clinical judgment.

Hearing loss

Hearing loss was defined as the use hearing aids or the inability to hear as well as an individual with normal hearing.

Mobility problems and using mobility aids

Presence of mobility problems was considered as existent if unsteady walking, difficulty in sitting and standing, difficulty in walking and moving, requiring use of mobility aids or falls were present. The use of a cane, crutches, and walking frame were noted as using mobility aids.

Malnutrition

Malnutrition is assessed by the Mini Nutritional Assessment in NHRs every six months. Participants who received oral nutritional supplements based on a score 7 and lower MNA, were recorded as having malnutrition.

Statistics

Data analyses were performed using SPSS version 25.0 for Windows. Normality was assessed by Kolmogorov-Smirnov's test. Normally distributed quantitative variables were expressed by mean $\pm$ standard deviations, and those without normal distribution were expressed by median and minimum-maximum values. Quantitative variables without normal distribution were expressed by mean $\pm$ standard deviations in the table if they have statistical significance. Qualitative variables were expressed as frequency and percentages. Chi-Square (X^2) test

Eur J Geriatr Gerontol

Kayhan Koçak et al. Polypharmacy and Geriatric Syndromes

and Fisher's exact test were used in the analysis of qualitative variables. The T test and Mann-Whitney U test were used in the analysis of quantitative variables where available. Multiple Logistic Regression Analysis was performed for multivariate analysis. Logistic Regression model was performed for variables which showed significant relationships with univariate analysis. A value of p < 0.05 was accepted as statistically significant.

Results

Of the NHRs, 54(24.9%) were in the 60–69 age group, 85 (39.2%) in the 70–79 age group and 78 (35.9%) in the 80 and over age group. Median (min-max) of age was 76 (61-110). Median (min-max) of medication number of all NHRs was 6 (0-17), 3 (0-4) in non-polypharmacy group, 7 (5-17) in polypharmacy group. Prevalence of polypharmacy was 61.8% in this study. Polypharmacy group had a higher hospital admission rate in last 6 months and a higher comorbidity prevalence than non-polypharmacy group. There was no relationship between polypharmacy and other socio-demographic characteristics. Descriptives of groups were shown in Table 1.

Of the NHRs, 38 (17.5%) had at least one chronic disease, 43 (19.8%) had two chronic diseases and 136 (62.7%) had three or more chronic diseases. The most common diseases were hypertension (58.5%), cardiovascular system diseases (27.2%) and benign prostatic hyperplasia (22.6%), followed by chronic obstructive pulmonary disease (COPD) and diabetes mellitus (DM) (19.4%). Falls, malnutrition, hearing loss, and vision impairment were not associated with polypharmacy. Comorbidity status according to polypharmacy were given in the Table 2.

Thirteen (6%) participants took one drug, fifty nine (27.2%) participants took two-four drugs, hundred and five (48.4%) participants took five-nine drugs, and twenty nine (13.3%) participants ten or more drugs. The most used drugs in both groups were angiotensin-converting enzyme inhibitor&angiotensin-2 receptor blocker, antiplatelet drugs, and diuretics. The most used drugs in NH were given in the Table 3.

All chronic diseases, except geriatric syndromes, were significantly associated with polypharmacy in univariate and multivariate analysis. Depression was found to be a better independent predictor of polypharmacy in NHRs compared with other co-morbidities (odds ratio (OR): 9.57; 95% confidence interval (CI): 2.73–33.6; p<0.001) (Table 4). However, depression had wide confidence intervals. In terms of geriatric syndromes, dementia and UI were not associated with polypharmacy in multivariate analysis (Table 4).

Table 1. Descriptive statistics of study participants			
	Non polypharmacy (n=83, 38.2%)	Polypharmacy (n=134, 61.8%)	p
Age (years)	74 (63-110)	77 (61-95)	0.19
Gender			0.21
M (n, %)	49 (59%)	69 (51.5%)	
F (n, %)	34 (41%)	65 (48.5%)	
Education level			0.18
Illiterate (n, %)	4 (4.8%)	15 (11.2%)	
Literate (n, %)	2 (2.4%)	7 (5.2%)	
1 to 11 years (n, %)	42 (50.6%)	63 (47%)	
12 years and above (n, %)	10 (12.1%)	8 (6%)	
Missing	25 (30.1%)	41 (30.6%)	
Marital status (n, %)			0.44
Single	17 (20.7%)	28 (20.7%)	
Married	9 (11%)	6 (4.4%)	
Divorced or widow	56 (67.1%)	97 (72.6%)	
Missing	1 (1.2%)	3 (2.2%)	
Length of stay in institution (n, %) *			0.48
0-6 months	4 (4.8%)	8 (5.97%)	
Above 6 months	79 (95.2%)	125 (93.3%)	
Missing		1 (0.75%)	
Hospital admission in the last 6 months (mean ± SD)	1.22±1.55	2.80±3.13	**<0.001**
Comorbidities (mean ± SD)	1.87±1.23	3.87±1.45	**<0.001**
*Fisher's Exact test, SD: Standard deviation, the bold values indicate the number for statistical significance			

Kayhan Koçak et al. Polypharmacy and Geriatric Syndromes

Eur J Geriatr Gerontol

Table 2. Comorbidities and geriatric syndromes according to polypharmacy status

Comorbidities	Non polypharmacy (n=83, 38.2%)	Polypharmacy (n=134, 61.8%)	p
KATZ score (median, min-max)	6 (5-6)	6 (5-6)	**0.017**
Diabetes mellitus	8 (9.6%)	34 (25.4%)	**0.004**
Arrhythmia	2 (2.4%)	20 (14.9%)	**0.003**
Cardiovascular disease	9 (10.8%)	50 (37.3%)	**<0.001**
Heart failure	1 (1.2%)	15 (11.2%)	**0.006**
Malignancy*	1 (1.2%)	9 (6.7%)	0.054
COPD	6 (7.2%)	36 (26.9%)	**<0.001**
Hypertension	37 (44.6%)	90 (67.2%)	**0.001**
Benign prostatic hyperplasia	13 (15.7%)	36 (26.9%)	0.055
Thyroid disease	4 (4.8%)	28 (20.9%)	**0.001**
Peripheral vascular disease	1 (1.2%)	14 (10.4%)	**0.01**
Parkinson disease	3 (3.6%)	6 (4.5%)	0.76
Geriatric syndromes			
Dementia	4 (4.8%)	19 (14.2%)	**0.03**
Depression	4 (4.8%)	33 (24.6%)	**<0.001**
Urinary Incontinence	5 (6%)	22 (16.4%)	**0.02**
Malnutrition *	0	3 (2.2%)	0.23
Falls*	5 (6%)	7 (5.2%)	0.51
Mobility problems	9 (10.8%)	42 (31.3%)	**0.01**
Using mobility aids	10 (12%)	39 (29.1%)	**0.003**
Hearing loss	12 (14.5%)	25 (18.7%)	0.42
Vision impairment	21 (25.3%)	35 (26.1%)	0.89

COPD: Chronic obstructive pulmonary disease, the bold values indicate the number for statistical significance, *Fisher's Exact test

Table 3. The most commonly used drugs in nursing homes

Drug type	Non polypharmacy (n=83, 38.2%)	Polypharmacy (n=134, 61.8%)	p
PPI	16 (19.3%)	60 (44.8%)	0.00
Antiplatelet drugs	23 (27.7%)	72 (53.7%)	0.00
ACE inhibitor or ARB	22 (26.5%)	71 (53%)	0.00
Diuretic	24 (28.9%)	65 (48.5%)	0.04
Beta blocker	13 (15.7%)	51 (38.1%)	0.00
Calcium channel blocker	10 (12%)	32 (23.9%)	0.032
Vasodilator	6 (7.2%)	33 (24.6%)	0.01
Inhaler beta mimetic	5 (6%)	36 (26.9%)	0.00
SSRI/SNRI	5 (6%)	34 (25.4%)	0.00
Vitamin supplement	5 (6.1%)	38 (28.4%)	0.00
Anticholinergic	6 (7.2%)	33 (24.6%)	0.001
Alpha blocker	10 (12%)	29 (21.6%)	0.074

ACE: Angiotensin-converting enzyme, ARB: Angiotensin II receptor blocker, SNRI: Serotonin and norepinephrine reuptake inhibitors, SSRI: Selective serotonin reuptake inhibitors, PPI: Proton pump inhibitors

Eur J Geriatr Gerontol

Kayhan Koçak et al. Polypharmacy and Geriatric Syndromes

Table 4. Logistic regression analysis where risk of polypharmacy was taken as a dependent variable							
Variables	**Polypharmacy (>5 drugs)**						
	Univariate models			**Multivariate model**			
	OR	95% CI	p	OR	95% CI	p	
CVD	4.89	2.25–10.62	**0.000**	5.71	2.22–14.66	**0.000**	
Hypertension	2.54	1.45–4.47	**0.001**	2.63	1.25–5.54	**0.011**	
COPD	4.71	1.89–11.76	**0.001**	7.04	2.29–21.60	**0,001**	
Depression	6.45	2.19–18.98	**0.001**	9.57	2.73–33.60	**0.000**	
Mobility problems	3.75	1.72–8.21	**0.001**	4.88	1.80–13.25	**0.002**	
Thyroid disease	5.22	1.76–15.48	**0.003**	6.53	1.83–23.31	**0.004**	
Diabetes mellitus	3.19	1.39–7.28	**0.006**	5.58	1.96–15.84	**0.001**	
Arrhythmia	7.11	1.61–31.25	**0.009**	7.02	1.31–37.47	**0.023**	
UI	3.06	1.11–8.44	**0.03**	2.06	0.58–7.28	0.26	
Dementia	3.26	1.07–9.96	**0.04**	3.28	0.82–13.18	0.094	
CVD: Cardiovascular disease, UI: Urinary incontinence, COPD: Chronic obstructive pulmonary disease							

Discussion

In this study, we aimed to determine relationship between polypharmacy and comorbidities, especially geriatric syndromes, in NHR without functional impairment. Prevalence of polypharmacy was 61.8% and polypharmacy was increased with depression and mobility problems.

There was significant difference between polypharmacy group and non-polypharmacy group in scores of Katz ADL. A cross-sectional, observational study conducted by 1002 community-dwelling older women showed that the use of five or more medications resulted in risk of decreasing instrumental ADL (IADL) score (23). A similar outcome was found by combining ADL and IADL (24). Furthermore, studies have found the negative association between ADL score and polypharmacy in chronic diseases (25–27). Also, there were a few studies that have not demonstrated the relationship between polypharmacy and functional decline in NH (28,29). Consequently, health professionals should be aware of the association between polypharmacy and functional decline.

Polypharmacy could be an indicator of an individual's underlying medical condition. There is heterogeneity among studies investigating relationship between polypharmacy and comorbidities (30). Like our study, Gocer et al found that prevalence of polypharmacy was higher in NHR with hypertension, heart disease and COPD (31). In a systematic review, cognitive impairment, hypertension, and DM were the most prevalent comorbidities in long-term care residents (5). Similarly, prevalence of polypharmacy has increased with an increase in number of chronic diseases among the community dwelling older adults (32). In a recent cross-sectional retrospective study, polypharmacy was more prevalent in geriatric outpatients with hypertension, DM, and COPD (33). As

for the coexistence of heart disease, DM, COPD, the number of medications inevitably increase. Also, the use of anticholinergic drugs strengthens the association between polypharmacy and comorbidities (32). If the medication was continued although the symptoms had resolved, negative outcomes occurred (34,35). As a result, medications used by older adults should be evaluated in accordance with international or national guidelines (15,36–39).

The presence of a geriatric syndrome is known to increase the risk of polypharmacy. In our study, by univariate analysis, geriatric syndromes such as dementia, depression, urinary incontinence, and mobility problems were significantly associated with polypharmacy. In the multivariate analyses, depression and mobility problems were significantly associated with polypharmacy and presences of these diseases increase polypharmacy by 9.6 and 4.8-fold respectively. The Shelter study found that polypharmacy was increased by 2-fold with depression (4). Similarly, depression was independently related to presence of polypharmacy and the use of potentially inappropriate medication in geriatric outpatients (12,14). A multicenter study based on the survey of health and ageing in Europe found that polypharmacy was associated with depression, lack of finance, lower ADL score (26). On the contrary to our findings, Küçükdağlı et al found that UI in geriatric outpatients was independently related to polypharmacy in univariate and multivariate analysis (14). As far as dementia is concerned, there was similar outcome in geriatric outpatients to our study (16). Our study conducted in NHRs with a KATZ score 5 and over. As a result, the study participants were functional and potentially less frail. Polypharmacy could have been related to a broader spectrum of geriatric syndromes, if the study population had been more functionally dependent.

Kayhan Koçak et al. Polypharmacy and Geriatric Syndromes

Eur J Geriatr Gerontol

Polypharmacy has a negative impact on conditions affecting mobility, such as falls and functional decline (40–42). We showed that polypharmacy was associated with mobility problems, not falls. A recent cross-sectional study carried out geriatric outpatients found that polypharmacy was independently associated with poor physical performance rather than falls (33). Several studies have shown a relationship between polypharmacy and falls (2). Izza et. al showed that the odds of falling increased by 1.058 times for every additional drug prescribed after adjusting for gender, age, and dementia (43). A study conducted to community-dwelling adults aged 55 years and over with a fall history indicated that the use of at least five daily prescribed molecules was associated with impaired Timed-Up and Go test after adjusting for number of comorbidities (44). The presence of the polypharmacy also is a significant risk factor for potentially inappropriate medication use. Thus, it poses a risk of geriatric syndromes (15). Some medications can increase the risk of geriatric syndrome because of their anticholinergic effects, sedative properties or by causing adverse drug reaction (45,46).

In the literature, the most used drugs in NHs were for heart disease medications (31,47). The most prevalent medications taken by all long-term care residents were gastrointestinal agent, diuretic and analgesic/antipyretic drugs in a systematic review (5). In a study conducted by 1843 NHR, they found that rate of use of cardiovascular medications (including antiplatelets, beta blockers, angiotensin-converting enzyme inhibitors, calcium channel blockers, and statins) was decreased following institutionalization over a period of one year (48). Also, in this study, the most common comorbidity was heart disease, as a result, the most frequently used drug group was cardiovascular medications.

Study Limitations

To our knowledge, this is the first study that has recently focused on the relationship between geriatric syndromes and polypharmacy in Turkish NHs. We realized that geriatric syndrome awareness was ensured through regular screening in NH. A relevant limitation of the study was number of NHR. Also, by the reason of conducting in one nursing home, the results cannot be generalized to all the NHR. Additionally, this study does not help to determine cause and effect for certain because of having cross sectional type. NHR were not evaluated with the comprehensive geriatric assessment, previously diagnosed health conditions were noted. Consequently, prevalence of geriatric syndromes can be even higher. Also, visual and hearing loss were assessed subjectively. Therefore, the associations between polypharmacy and visual and hearing loss might not be as well determined.

Conclusion

Comorbidity and geriatric syndromes play a significant role in the prevalence of polypharmacy. Assessment of polypharmacy is necessary during the administration of complex medication regimens for NHR. There was a statistical difference in Katz score between polypharmacy group and non-polypharmacy group in this study, although it was conducted among individuals who were described independent with Katz ADL. This is the first study evaluating the relationship between polypharmacy and geriatric syndromes in NHRs in Turkey. Given the scarcity of the studies on this subject and difficulty of getting permission for research in Turkish NHs, we believe that this study is valuable. Polypharmacy is common in NHs and is associated with geriatric syndromes. We believe that prevalence of polypharmacy will increase even further as evaluated through a comprehensive geriatric assessment. With prospective studies, the effect of deprescribing on geriatric syndromes can be investigated. Also, the studies investigating the prescription cascade are needed.

Authorship Contributions

Surgical and Medical Practices: F.Ö.K.K., E.T. Concept: F.Ö.K.K., E.T., S.Ş. Design: F.Ö.K.K., E.T., Data Collection or Processing: F.Ö.K.K., E.T., Analysis or Interpretation: F.Ö.K.K., E.T., Literature Search: F.Ö.K.K., E.T., Writing: F.Ö.K.K., E.T.

References

1. Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE. What is polypharmacy? A systematic review of definitions. BMC Geriatrics. 2017 Dec 10;17(1):230.

2. Pazan F, Wehling M. Polypharmacy in older adults: a narrative review of definitions, epidemiology and consequences. European Geriatric Medicine. 2021 Jun 10;12(3):443–52.

3. World Health Organization (WHO) (2019) Medication Safety in Polypharmacy (WHO/UHC/SDS/2019.11). [Internet]. 2020 [cited 2022 Mar 13]. Available from: https ://apps.who.int/iris/ bitst ream/handl e/10665 /32545 4/WHO-UHC-SDS-2019.11-eng. pdf?ua=

4. Onder G, Liperoti R, Fialova D, Topinkova E, Tosato M, Danese P, et al. Polypharmacy in Nursing Home in Europe: Results From the SHELTER Study. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences. 2012 Jun 1;67A(6):698–704.

5. Jokanovic N, Tan ECK, Dooley MJ, Kirkpatrick CM, Bell JS. Prevalence and Factors Associated With Polypharmacy in Long-Term Care Facilities: A Systematic Review. Journal of the American Medical Directors Association. 2015 Jun;16(6):535.e1-535.e12.

6. Aubert CE, Streit S, da Costa BR, Collet T-H, Cornuz J, Gaspoz J-M, et al. Polypharmacy and specific comorbidities in university primary care settings. European Journal of Internal Medicine. 2016 Nov;35:35–42.

7. Tamura BK, Bell CL, Inaba M, Masaki KH. Factors Associated With Polypharmacy in Nursing Home Residents. Clinics in Geriatric Medicine. 2012 May;28(2):199–216.

8. Shah BM, Hajjar ER. Polypharmacy, Adverse Drug Reactions, and Geriatric Syndromes. Clinics in Geriatric Medicine. 2012 May;28(2):173–86.

9. Maher RL, Hanlon J, Hajjar ER. Clinical consequences of polypharmacy in elderly. Expert Opinion on Drug Safety. 2014 Jan 27;13(1):57–65.

Eur J Geriatr Gerontol

Kayhan Koçak et al. Polypharmacy and Geriatric Syndromes

10. Bronskill SE, Gill SS, Paterson JM, Bell CM, Anderson GM, Rochon PA. Exploring Variation in Rates of Polypharmacy Across Long Term Care Homes. Journal of the American Medical Directors Association. 2012 Mar;13(3):309.e15-309.e21.

11. Chang TI, Park H, Kim DW, Jeon EK, Rhee CM, Kalantar-Zadeh K, et al. Polypharmacy, hospitalization, and mortality risk: a nationwide cohort study. Scientific Reports. 2020 Dec 3;10(1):18964.

12. Yuruyen M, Yavuzer H, Demirdag F, Kara Z, Cengiz M, Yavuzer S, et al. Is Depression a Predictive Factor for Polypharmacy in Elderly? Klinik Psikofarmakoloji Bülteni-Bulletin of Clinical Psychopharmacology. 2016 Dec 25;26(4):374–81.

13. EFE M, SARAÇ ZF, SAVAŞ S, KILAVUZ A, AKÇİÇEK SF. Sarcopenia prevalence and the quality of life in older adults: A study from Turkey's east. Ege Tıp Dergisi. 2021 Apr 19;52–9.

14. Küçükdağlı P. Polypharmacy and Related Factors in Geriatric Outpatients. European Journal of Geriatrics and Gerontology. 2019 Oct 24;1(2):56–60.

15. Kucukdagli P, Bahat G, Bay I, Kilic C, Oren MM, Turkmen BO, et al. The relationship between common geriatric syndromes and potentially inappropriate medication use among older adults. Aging Clinical and Experimental Research. 2020 Apr 12;32(4):681–7.

16. Erbas Sacar D. Association Between Dementia and Common Geriatric Syndromes. European Journal of Geriatrics and Gerontology. 2020 Nov 16;2(3):71–6.

17. SENGUL AYCICEK G, ARIK G, KIZILARSLANOGLU MC, SUMER F, PALA OO, CAN B, et al. Association of polypharmacy with postural instability and impaired balance in community-dwelling older adults in Turkey. Marmara Medical Journal. 2021 Jan 27;12–7.

18. Tasar PT, Sahin S, Karaman E, Ulusoy MG, Duman S, Berdeli A, et al. Prevalence and risk factors of sarcopenia in elderly nursing home residents. European Geriatric Medicine. 2015 Jun;6(3):214–9.

19. Yalcin A, Aras S, Atmis V, Cengiz OK, Cinar E, Atli T, et al. Sarcopenia and mortality in older people living in a nursing home in Turkey. Geriatrics & Gerontology International. 2017 Jul;17(7):1118–24.

20. Katz S. Assessing self-maintenance: activities of daily living, mobility, and instrumental activities of daily living. Journal of the American Geriatrics Society. 1983 Dec;31(12):721–7.

21. Ferner RE, Aronson JK. Communicating information about drug safety. BMJ (Clinical research ed). 2006 Jul;333(7559):143–5.

22. Lamb SE, JÃ¸rstad-Stein EC, Hauer K, Becker C. Development of a Common Outcome Data Set for Fall Injury Prevention Trials: The Prevention of Falls Network Europe Consensus. Journal of the American Geriatrics Society. 2005 Sep;53(9):1618–22.

23. Crentsil V, Ricks MO, Xue Q-L, Fried LP. A pharmacoepidemiologic study of community-dwelling, disabled older women: Factors associated with medication use. The American Journal of Geriatric Pharmacotherapy. 2010 Jun;8(3):215–24.

24. Connolly D, Garvey J, McKee G. Factors associated with ADL/IADL disability in community dwelling older adults in the Irish longitudinal study on ageing (TILDA). Disability and Rehabilitation. 2017 Apr 10;39(8):809–16.

25. Goyal P, Bryan J, Kneifati-Hayek J, Sterling MR, Banerjee S, Maurer MS, et al. Association Between Functional Impairment and Medication Burden in Adults with Heart Failure. Journal of the American Geriatrics Society. 2019 Feb;67(2):284–91.

26. Mohamed MR, Ramsdale E, Loh KP, Xu H, Patil A, Gilmore N, et al. Association of Polypharmacy and Potentially Inappropriate Medications With Physical Functional Impairments in Older Adults With Cancer. Journal of the National Comprehensive Cancer Network. 2021 Mar;19(3):267–74.

27. Bahat G, Tufan F, Bahat Z, Tufan A, Aydin Y, Akpinar TS, et al. Comorbidities, polypharmacy, functionality and nutritional status in Turkish community-dwelling female elderly. Aging Clinical and Experimental Research. 2014 Jun 30;26(3):255–9.

28. Wilson NM, Hilmer SN, March LM, Cameron ID, Lord SR, Seibel MJ, et al. Associations between drug burden index and physical function in older people in residential aged care facilities. Age and Ageing. 2010 Jul 1;39(4):503–7.

29. Vetrano DL, Villani ER, Grande G, Giovannini S, Cipriani MC, Manes-Gravina E, et al. Association of Polypharmacy With 1-Year Trajectories of Cognitive and Physical Function in Nursing Home Residents: Results From a Multicenter European Study. Journal of the American Medical Directors Association. 2018 Aug;19(8):710–3.

30. Fried TR, O'Leary J, Towle V, Goldstein MK, Trentalange M, Martin DK. Health Outcomes Associated with Polypharmacy in Community-Dwelling Older Adults: A Systematic Review. Journal of the American Geriatrics Society. 2014 Dec;62(12):2261–72.

31. Gocer S, Gunay O, Polat T, Ulutabanca R, Sonkaya Z. Polypharmacy and associated factors in people living in a nursing home in Kayseri Turkey. Medicine Science | International Medical Journal. 2017;1.

32. Masnoon N, Kalisch Ellett L, Shakib S, Caughey GE. Predictors of Mortality in the Older Population: The Role of Polypharmacy and Other Medication and Chronic Disease-Related Factors. Drugs & Aging. 2020 Oct 4;37(10):767–76.

33. Ozkok S, Aydin CO, Sacar DE, Catikkas NM, Erdogan T, Kilic C, et al. Associations between polypharmacy and physical performance measures in older adults. Archives of Gerontology and Geriatrics. 2022 Jan;98:104553.

34. Bahat G, Bay I, Tufan A, Tufan F, Kilic C, Karan MA. Prevalence of potentially inappropriate prescribing among older adults: A comparison of the Beers 2012 and Screening Tool of Older Person's Prescriptions criteria version 2. Geriatrics & Gerontology International. 2017 Sep;17(9):1245–51.

35. Krishnaswami A, Steinman MA, Goyal P, Zullo AR, Anderson TS, Birtcher KK, et al. Deprescribing in Older Adults With Cardiovascular Disease. Journal of the American College of Cardiology. 2019 May;73(20):2584–95.

36. Mangin D, Bahat G, Golomb BA, Mallery LH, Moorhouse P, Onder G, et al. International Group for Reducing Inappropriate Medication Use & Polypharmacy (IGRIMUP): Position Statement and 10 Recommendations for Action. Drugs & Aging. 2018 Jul 14;35(7):575–87.

37. Bahat G, Ilhan B, Erdogan T, Oren MM, Karan MA, Burkhardt H, et al. International Validation of the Turkish Inappropriate Medication Use in the Elderly (TIME) Criteria Set: A Delphi Panel Study. Drugs & Aging. 2021 Jun 13;38(6):513–21.

38. Bahat G, İlhan B, Erdoğan T, Halil M, Savaş S, Ülger Z, et al. Presenting Turkish Inappropriate Medication Use in the Elderly (TIME) Criteria Set in Turkish. European Journal of Geriatrics and Gerontology. 2021 Aug 1;3(2):40–100.

39. Bahat G, Ilhan B, Erdogan T, Halil M, Savas S, Ulger Z, et al. Turkish inappropriate medication use in the elderly (TIME) criteria to improve prescribing in older adults: TIME-to-STOP/TIME-to-START. European Geriatric Medicine. 2020 Jun 5;11(3):491–8.

40. Peron EP, Gray SL, Hanlon JT. Medication Use and Functional Status Decline in Older Adults: A Narrative Review. The American Journal of Geriatric Pharmacotherapy. 2011 Dec;9(6):378–91.

41. Zia A, Kamaruzzaman SB, Tan MP. Polypharmacy and falls in older people: Balancing evidence-based medicine against falls risk. Postgraduate Medicine. 2015 May 4;127(3):330–7.

42. Ali MU, Sherifali D, Fitzpatrick-Lewis D, Kenny M, Liu A, Lamarche L, et al. Polypharmacy and mobility outcomes. Mechanisms of Ageing and Development. 2020 Dec;192:111356.

43. Izza MAD, Lunt E, Gordon AL, Gladman JRF, Armstrong S, Logan P. Polypharmacy, benzodiazepines, and antidepressants, but not antipsychotics, are associated with increased falls risk in UK care home residents: a prospective multi-centre study. European Geriatric Medicine. 2020 Dec 19;11(6):1043–50.

44. Langeard A, Pothier K, Morello R, Lelong-Boulouard V, Lescure P, Bocca M-L, et al. Polypharmacy Cut-Off for Gait and Cognitive Impairments. Frontiers in Pharmacology. 2016 Aug 31;7.

Kayhan Koçak et al. Polypharmacy and Geriatric Syndromes

Eur J Geriatr Gerontol

45. Pana A, Sourtzi P, Kalokairinou A, Velonaki VS. Sarcopenia and polypharmacy among older adults: A scoping review of the literature. Archives of Gerontology and Geriatrics. 2022 Jan;98:104520.

46. George CJ, Verghese J. Motoric Cognitive Risk Syndrome in Polypharmacy. Journal of the American Geriatrics Society. 2020 May 24;68(5):1072–7.

47. Altıparmak S, Altıparmak O. Drug-using behaviors of the elderly living in nursing homes and community-dwellings in Manisa, Turkey. Archives of Gerontology and Geriatrics. 2012 Mar;54(2):e242–8.

48. Onder G, Vetrano DL, Villani ER, Carfi A, lo Monaco MR, Cipriani MC, et al. Deprescribing in Nursing Home Residents on Polypharmacy: Incidence and Associated Factors. Journal of the American Medical Directors Association. 2019 Sep;20(9):1116–20.