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RESEARCH

EVALUATION OF POTENTIALLY INAPPROPRIATE DRUG USE AND MEDICAL NON-ADHERENCE IN A COMMUNITY-DWELLING ELDERLY POPULATION: A CROSS-SECTIONAL STUDY

ABSTRACT

Introduction: The objectives of the study were to evaluate potentially inappropriate drug use and medical non-adherence and to determine the risk factors for potentially inappropriate drug use and medical non-adherence in the elderly dwelling in a community health center service area.

Materials and Method: The cross-sectional study included all individuals aged 65 years and older (n=687) dwelling in the area of a community health center in Isparta, Turkey. The dependent variables of the study were potentially inappropriate drug use and medical non-adherence. The structured questionnaire, comprising both dependent and independent variables, was administered to elderly people by conducting face-to-face interviews at home. Chi-square, independent samples t-test, and logistic regression were used for data analysis.

Results: Among the elderly using at least one drug per day, 17.6% were using at least one potentially inappropriate medication. Non-steroidal anti-inflammatory drugs and digoxin (in doses >0.125 mg/day) were the most common drugs that were used inappropriately. Medical non-adherence was determined in 40.6% of the elderly. The most common non-adherent behavior was "forgetting to take the medication." In the multivariate analysis, polymorbidity (p=0.001) and polypharmacy (p=0.016) were risk factors for potentially inappropriate drug use. The only risk factor for medical non-adherence was "not knowing most of the side effects of the drug" (p=0.018).

Conclusion: In this study, lower prevalence rates than those for most previous studies were found for both potentially inappropriate drug use and medical non-adherence. Since polymorbidity and polypharmacy were risk factors for potentially inappropriate drug use, physicians should be cautious in the selection of drugs for elderly patients with polymorbidity.

Key Words: Aged, Inappropriate Prescribing; Medication Adherence.

ARAŞTIRMA

TOPLUMDA YAŞLILARDA UYGUNSUZ İLAÇ KULLANMA OLASILIĞI VE İLAÇ UYUMSUZLUĞUNUN DEĞERLENDİRİLMESİ, KESİTSEL BİR ÇALIŞMA

ÖZ

Giriş: Bu çalışmada bir toplum sağlığı hizmet bölgesinde yaşayan yaşlıların uygunsuz ilaç kullanma olasılığının ve ilaç uyumsuzluğunun değerlendirilmesi ile potansiyel uygunsuz ilaç kullanımı ve ilaç uyumsuzluğu için risk faktörlerinin belirlenmesi amaçlanmıştır.

Gereç ve Yöntem: Kesitsel tipteki çalışma Türkiye'nin İsparta ilindeki bir Toplum Sağlığı Bölgesinde yaşayan 65 yaş üzeri 687 yaşlı bireyi kapsamaktadır. Araştırmanın bağımlı değişkenleri uygunsuz ilaç kullanma olasılığı ve ilaç uyumsuzluğudur. Araştırmanın bağımlı ve bağımsız değişkenlerini içeren yapılandırılmış anket, yaşlılara evlerinde yüz-yüze görüşme yöntemiyle uygulanmıştır. Veri analizinde ki-kare, bağımsız gruplarda t-testi ve lojistik regresyon kullanılmıştır.

Bulgular: Her gün en az bir ilaç kullanan yaşlıların %17,6'sı en az bir adet uygunsuz ilaç kullanım olasılığını tanımlamışlardır. Non-steroid anti-inflamatuar ilaçlar ve digoxin (>0,125 mg/gün) en sık uygunsuz kullanılan ilaçlardı. Yaşlıların %40,6'sında ilaç uyumsuzluğu saptandı. İlaç uyumsuzluğunu belirleyen davranışlar içinde "ilaç içmeyi unutma" en sık görüldü. Çok değişkenli analizlerde polimorbidite (p=0,001) ve polifarmasi (p=0,016) uygunsuz ilaç kullanma olasılığı için risk faktörleriydi. İlaç uyumsuzluğu için tek risk faktörü "kullanılan ilaçların çoğu yan etkisini bilmemek"ti (p=0,018).

Sonuç: Bu çalışmada uygunsuz ilaç kullanma olasılığı ve ilaç uyumsuzluğu sıklığı diğer çalışmaların çoğundan daha düşüktü. Polifarmasi ve polimorbiditenin uygunsuz ilaç kullanma olasılığı için risk faktörleri olması nedeniyle hekimler polimorbiditesi olan yaşlı hastalarda ilaç seçiminde dikkatli olmalıdır.

Anahtar Sözcükler: Yaşlı; Uygunsuz İlaç Kullanımı; İlaç Uyumu.

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Introduction

With increasing age, physiological variations occur in the absorption, distribution, metabolism and excretion of drugs from the body, and the sensitivity of receptors. Moreover, multiple chronic diseases and related polypharmacy are frequently present in the elderly. Therefore, elderly people are more liable to medication-related problems including adverse drug reactions, and drug-drug and drug-disease interactions (1,2). Many medications involve special risks when used by the elderly and are considered potentially inappropriate for this population. Potentially inappropriate drug use (PIDU) in older adults is a major health concern. Previous studies have demonstrated that PIDU is related to increased number of hospitalizations and mortality (3) and causes a poorer health status (4). Leading authorities have proposed different screening tools for determining the potentially inappropriate drugs that should be avoided in the elderly. Among these tools, the Beers criteria are the most frequently used ones. The Beers Criteria were developed in 1991 and revised and modified three times in 1997, 2003 and 2012 (5,6). According to Gallagher et al.'s review based on the Beers criteria, PIDU prevalence in the elderly varies from 12% in the community-dwelling elderly to 40% in nursing home residents (7).

The frequency of chronic diseases, cognitive and physical deficiencies and the number of drugs utilized increase with older age and this causes medical non-adherence (MN) as well as PIDU to become a major health issue. Medication adherence is defined as the degree to which a patient's or caregiver's behavior regarding medication administration coincides with medical advice (8). Adherence to treatments is essential to the well-being of elderly patients, and is thus a critically important component of care. In the elderly, failure to adhere to medical recommendations and treatment has been found to increase the likelihood of therapeutic failure (9,10). Non-compliance or non-adherence with drug therapy in older patient populations ranges from 21 to 55 percent (11).

In this study we aimed to evaluate potentially inappropriate drug use and medication non-adherence and to determine the risk factors for PIDU and MN in the elderly dwelling in a community health center service area.

Materials and Method

Study Design and Study Population

This cross-sectional survey was conducted in October 2013. The study population consisted of 687 individuals aged 65 years and older dwelling in the catchment area of the Community Health Center of the Gonen District of Isparta, Turkey. Gonen is a rural district comprising a center, a town, and six villages with a population of 7800 people. Since we aimed to reach the whole population, we did not select a sample. By the end of the study 563 elder individuals had been reached (response rate 82.0%). People who could not be found at home (85 subjects, *12.4%)* and who rejected participation (39 subjects, 5.6%) were not included.

Dependent and Independent Variables

The dependent variables of the study were PIDU and **MN.** PIDU was determined by the Beers criteria, which were updated in 2012 (6). The Beers criteria comprise three categories. The first category consists of drugs that should be avoided independent of the disease; the second category consists of drugs that should be avoided in the presence of certain diseases or syndromes; and the third category consists of drugs that should be used with caution (6). In this study PIDU was evaluated concerning the first two categories. Accordingly, PIDU was accepted to be present if there was at least one inappropriate drug use by the elderly. The presence of MN was evaluated using the scale developed by Morisky and colleagues, consisting of four closed-ended yes/no questions (12): 1) Do you ever forget to take your medicine? 2) Are you careless at times about taking your medicine? 3) When you feel better do you sometimes stop taking your medicine? and 4) Sometimes if you feel worse when you take the medicine, do you stop taking it? MN was evaluated to be present with a "yes" answer to at least one of these questions (13,14).

Age, sex, marital status, presence of health insurance, regular income, living alone/with others, area of residence, receiving health care in the last six months, health perception, polymorbidity, polypharmacy, knowing the aim of the use of the drugs, knowing most of the adverse effects of the drugs, presence of depressive symptoms, dependence during basic daily living activities, and problems of vision and hearing were investigated as independent variables. Utilization of five or more drugs was accepted as polypharmacy, while the presence of three or more chronic diseases was accepted as polymorbidity. In order to evaluate the presence of depressive symptoms the Geriatric Depression Scale (GDS) was used. This scale was developed by Yesavage and colleagues. It comprises 30 items and the validity and reliability of the Turkish version has been established by Ertan and Eker (15). The scale was scored between 0 and 30, and higher scores indicate the presence of more depressive symptoms. Dependence in basic

daily living activities was evaluated using the Barthel Index. The maximum score obtained from the scale is 100 and it indicates complete independence. People scoring 90 points or less were accepted as being dependent (16).

Data Collection

The structured questionnaire comprising the dependent and independent variables was administered to the elderly people in the study by conducting face-to-face interviews at home. Subjects who could not be found at home in the first trial were re-visited twice. In the case of a communication problem (hearing, speech and/or mental problem) the questionnaire was administered to the primary caregiver. Drug utilization data consisted of the names and durations of the drugs used daily. To minimize underreporting, boxes and/or the prescriptions for the drugs were asked for, and the brand names of the drugs were recorded. During data analysis drugs were categorized according to the Anatomical Therapeutic Chemical (ATC) Classification (17). Data on doses and duration of drugs were also collected. Chronic diseases and syndromes were investigated in detail.

Ethical Issues

The study was approved by the Ethical Committee for Clinical Studies of Siileyman Demirel University School of Medicine (Registration Number: 187). Verbal informed consents were obtained from participants following a brief explanation of the aim of the study.

Data Analysis

The data were analyzed using the SPSS 18.0 for Windows program. Variables were presented as frequencies, percentages, or mean±±standard deviations. The groups were compared by using chi-square and independent samples t-test for univariate analyses and logistic regression for multivariate analyses. Two logistic regression models were built in order to determine the risk factors affecting PIDU and MN. The factors that were determined to be significant in the univariate analyses were included in the models. One-tailed p-values were used and $p<0.05$ was set as the value for significance.

RESULTS

Descriptive Characteristics of the Study Population

The mean age of the study group was 74.9±±7.0 years (range 65-100), of which 29.1% were 80 years old and above (Table 1). Other descriptive data are shown in Table 1. Most participants (87.4%) had been admitted to a health institution in the last six months (Table 1). The mean admission frequency in the last six months was 2.8±±2.4 (range 0-13), and the most frequently admitted institutions were family health centers (n=355, 72.2%), state hospitals (n=225, 45.7%), and university hospitals (n=42, 8.6%).

Of the elderly, 53.6% (n=302) reported problems with their vision, while 41.9% (n=236) reported problems with hearing. The mean basic daily living activity score was 95.7±±12.0 (range 5-100), and 16.5 % (n=93) were evaluated as "being dependent". The mean GDS score was 8.5±±7.4 (range 0-30).

Table 1— Characteristics of the Study Population (N=563).

Characteristic	Value
Age, year, mean±sd (range)	74.9±7.0 (65-100)
Age groups, n (%)	
65-69	141 (25.0)
70-74	137 (24.3)
75-79	121 (21.5)
>80	164 (29.1)
Sex, n (%)	
Female	340 (60.4)
Male	223 (39.6)
Education level, n (%)	
Illiterate	164 (29.1)
Just literate	114 (20.2)
Primary school	265 (47.1)
Secondary school or above	20 (3.6)
Marital status, n (%)	
Married	345 (61.3)
Widowed/Divorced/Single	218 (38.7)
Area of residence, n (%)	
District center	214 (38.0)
Town	124 (22.0)
Village	225 (40.0)
Living alone, n (%)	157 (27.9)
Regular income, n(%)	490 (87.0)
Health coverage, n (%)	508 (90.2)
Health perception, n (%)*	
Very good	12 (2.2)
Good	273 (50.2)
Fair	201 (36.9)
Poor	54 (9.9)
Very poor	4 (0.7)
Use of health service in the last six months, n (%)	492 (87.4)

*Health perception was evaluated using data involving 544 subjects since data concerning 19 older adults were.

Table 2— Characteristics of the Study Group Concerning Chronic Diseases and Drug Use (N= 563).

Characteristic	Value
Presence of chronic disease(s), n (%)	429 (76.2)
The number of chronic disease(s), mean±SD (range)*	1.9±.1.1 (1-8)
Presence of polymorbidity, n (%)	106(18.8)
Chronic disease(s), n (%)*	
Hypertension	254 (45.1)
Heart failure	107(19.0)
Diabetes mellitus	83 (14.7)
Joint diseases	48 (8,5)
Chronic obstructive pulmonary disease/asthma	45 (8.0)
Osteoporosis	38 (6.7)
Depression	21 (3.7)
Use of at least one drug per day, n (%)	409 (72.6)
Total number of drugs used per day, mean±SD (range)*	3.1±1.9 (1-11)
Presence of polypharmacy, n (%)	80(14.2)
Drugs used per day (According to ATC), n (%)§	
Cardiovascular system	487 (38.5)
Alimentary tract and metabolism	255 (20.2)
Nervous system	208 (16.4)
Respiratory system	73 (5.8)
Musculoskeletal system	72 (5.7)
Blood and blood forming organs	39 (3.1)
Other systems	131 (10.4)
Presence of medical non-adherence*	166 (40.6)
Components of medical non-adherence[1]	
Forgetting to take the drug	114(27.9)
Carelessness in taking the drug on time	87 (21.2)
Stopping the drug when feeling better	66 (16.1)
Stopping the drug when feeling worse	59 (14.4)

*429 subjects with at least one disease were evaluated.
*The most frequent seven diseases were listed.
*409 subjects who used at least one drug per day were evaluated. §A total of 1265 drugs used by 409 subjects were evaluated.
[1]The same subject may have more than one non-adherence components simultaneously.

Of the participants, 76.2% had at least one chronic disease. The prevalence of polymorbidity was 18.8%). Hypertension was the most common chronic disease (45.1%). Approximately three-quarters of the group (72.6%) was using at least one drug daily. The mean number of drugs used was 3.1±±1.9 (range 1-11), cardiovascular system drugs being the most frequent (38.5%). Polypharmacy prevalence was 14.2% (Table 2). All the participants reported drug use on the advice of a physician. Of our group, 81.4% (n=333) reported that they knew the aim of the drug use, while only 19.3% (n=79) reported they knew most of the side effects of the drugs.

Medical Non-adherence and Potentially Inappropriate Drug Usage

Medical non-adherence was present in 40.6% (n=166) of the elderly. When the components of MN were evaluated, the most important problem was determined to be forgetting to take the drug (27.9%) (Table 2).

Of the elderly, 17.6% (n=72) had at least one PIDU (Table 3). Of the elderly with PIDU, 90.3% (n=65) had one drug utilization, 8.3% (n=6) had two, and 1.4% (n=l) had three inappropriate drug utilizations.

The most frequently used inappropriate drugs were non-steroidal anti-inflammatory drugs (NSAIDs) (n=30, 7.3%) and digoxin >0.125 mg/day (n=12, 2.9%) independent of the disease. Related to the disease or syndrome, the most frequently used inappropriate drugs were NSAIDs (n=10, 2.4%>) and non-dihydropyridine group calcium-channel blockers (n=9, 2.2%) in patients with heart failure (Table 3). When the drugs that are not accepted as inappropriate but recommended to be used with caution in the elderly were investigated, it was determined that the study group most frequently used aspirin (5.6%) and selective serotonin re-uptake inhibitors (SSRIs) (5.6%) (Table 3).

Factors Associated With Potentially Inappropriate Drug Use and Medical Non-adherence

We found that sociodemographic factors such as age, sex, education level, marital status and living alone were not significantly related to PIDU and MN (for all factors p>0.05) (Table 4). There were no significant relationships between PIDU and MN and regular income, presence of health coverage, area of residence, and admission to a health institute in the last six months (for all of the factors p>0.05). Hearing and vision problems, dependence in daily living activities and health perception did not affect PIDU and MN significantly (for all factors p>0.05) (Table 4).

There were no significant differences between the subjects with PIDU (9.1±±7.4) and without PIDU (9.2±±7.8) in terms of GDS score (p=0.873). Similarly, the GDS scores of the subjects with MN (9.1±±7.9) and without MN (9.3±±7.6) were not significantly different (p=0.795). According to the univariate analysis results, PIDU was significantly higher in subjects with polymorbidity (34.9% vs

Table 3— Potentially Inappropriate Drug Use and Drugs Recommended to Be Used With Caution in Community-dwelling Elderly (N=409)*.

Characteristic	Value
At least one inappropriate drug use	72(17.6)*
Inappropriately used drugs independent from disease	
First generation antihistamines	
Hydroxyzine	2 (0.5)
Clemastine	1 (0.2)
Antithrombotics	
Dipyridamole	4(1,0)
Alphai blockers	
Doxazosin	5(1.2)
Anti-arrhythmic drugs	
Amiodarone	1 (0.2)
Digoxin (>0.125 mg/d)	12 (2.9)
Nifedipine	1 (0.2)
Benzodiazepines	
Alprazolam	1 (0.2)
Non-steroidal anti-inflammatory drugs*	
Diclofenac	14 (3.4)
Ibuprofen	1 (0.2)
Ketoprofen	3 (0.7)
Meloxicam	4(1,0)
Naproxen	3 (0.7)
Indomethacin	5(1.2)
Inappropriately used drugs related to disease or syndrome	
Heart failure	
Non-steroidal anti-inflammatory drugs	10 (2.4)
Diltiazem	8 (2.0)
Verapamil	1 (0.2)
Dementia	
Antipsychotics	2 (0.5)
Chronic constipation	
Solifenacin	1 (0.2)
Trospium	1 (0.2)
History of gastric or duodenal ulcers	
Non-Cox-2 selective non-steroidal anti-inflammatory drugs	3 (0.7)
Drugs recommended to be used with caution in elderly	
Aspirin for primary prevention of cardiac events§	23 (5.6)
Antipsychotics	1 (0.2)
Carbamazepine	2 (0.5)
Mirtazapine	3 (0.7)
Selective serotonin re-uptake inhibitors	23 (5.6)
Vasodilators	3 (0.7)

*409 subjects who used at least one drug per day were evaluated.
*Some of the older subjects may use more than one inappropriate drug independent from disease and a drug may be inappropriately used both independent from the disease and with respect to disease/syndrome
*Subjects using Non-steroidal anti-inflammatory drugs without a proton pump inhibitor or misoprostol for more than 3 months.
§Subjects aged 80 or older using aspirin independent from dose.

11.6%), polypharmacy (36.3% vs 13.1%), and in subjects who did not know the aim of the drug use (26.3% vs 15.6%) (for all factors p<0.05) (Table 4). These three variables were included in the logistic regression model that revealed only polymorbidity and polypharmacy to be significant risk factors. PIDU was associated with an odds ratio of 2.84 (95% CI=1.55-5.20) for polymorbidity and 2.21 (95% CI=1.16-4.19) for polypharmacy (Table 5). Univariate analyses revealed that MN was more frequent in the subjects who knew neither the aim of their drug usage nor most of the side effects of the drugs (p<0.05) (Table 4). In the logistic regression model that included these two variables, "not knowing most of the side effects of the drug" was a significant risk factor for MN (OR=1.96, 95% CI =1.12-3.41) (Table 5).

Discussion

In this study PIDU and MN, which are two important problems related to drug utilization, were evaluated in elderly people with a relatively lower education level living in the rural area of Isparta city.

Potentially Inappropriate Drug Usage

According to the results of our study, PIDU prevalence was estimated as 17.6% in community-dwelling older adults. The most frequent inappropriately used drugs were NSAIDs and digoxin. According to the Beers criteria, NSAIDs increase the risk of peptic ulcer disease and gastrointestinal system bleeding in high-risk groups aged >75 years and taking oral/parenteral corticosteroids, anticoagulants or antiplatelet agents. Upper gastrointestinal system ulcers, gross bleeding and perforation risk are present in 1% of subjects who have been using NSAIDs for 3-6 months, and in 2% of subjects who have been using NSAIDs for 1 year (6). In our study 18 subjects had been using NSAIDs for more than 6 months, and 12 subjects had been using NSAIDs for 3-6 months. Three subjects were using two different NSAIDs concomitantly. Using >0.125 mg/day digoxin, which has a narrow therapeutic index, does not confer an additional benefit in patients with heart failure and increases the risk of serious side effects and toxicity signs related to decreased renal clearance (6).

It was supposed that in patients with heart failure, drugs such as NSAIDs, diltiazem and verapamil might increase fluid retention and exacerbate heart failure symptoms (6). In our study among the heart failure patients, 10 were using NSAIDs, 8 were using diltiazem and 1 was using verapamil. Therefore, the physicians' knowledge, particularly about the

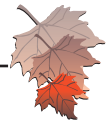

Table 4— Distribution of Potentially inappropriate Drug Use and Medical Non-adherence Concerning Some Variables (n=409)*.

Variable	Potentially Inappropriate Drug Use		Medical Non-adherence	
	n (%)f	P*	n (%)f	P*
Age groups				
65-74 (n=206)				
>75(n=203)	32(15.5) 40 (19.7)	0.268	88 (42.7) 78 (38.4)	0.377
Sex				
Female (n=258)	45 (17.4)	0.910	100 (38.8)	0.325
Male (n=151)	27(17.9)		66 (43.7)	
Education level				
Illiterate (n=127)	23 (18.1)	0.792	56 (44.1)	0.431
Just literate (n=80)	12(15.0)		28 (35.0)	
Primary school or above (n=202)	37(18.3)		82 (40.6)	
Marital status				
Married (n=241)	41 (17.0)	0.707	99 (41.1)	0.808
Other (n= 168)	31 (18.5)		67 (39.9)	
People lived with				
Living alone (n=125)	20(16.0)	0.572	57 (45.6)	0.171
Living with family (n=284)	52(18.3)		109 (38.4)	
Vision problems				
Present (n=227)	34(15.0)	0.119	95 (41.9)	0.561
Absent (n= 182)	38 (20.9)		71 (39.0)	
Hearing problems				
Present (n=176)	30(17.0)	0.797	80 (45.5)	0.081
Absent (n=233)	42(18.0)		86 (36.9)	
Dependence in basic daily living activities				
Dependent (n=69)	13 (18.8)	0.767	34 (49.3)	0.107
Independent (n=340)	59 (17.4)		132 (38.8)	
Health perception				
Very good/good (n=199)	40 (20.1)	0.197	83 (41.7)	0.653
Fair/poor/very poor (n=210)	32(15.2)		210 (39.5)	
Polymorbidity				
No (n=303)	35 (11.6)	**<0.001**	129 (42.6)	0.166
Yes (n=106)	37 (34.9)		37 (34.9)	
Polypharmacy				
No (n=329)	43 (13.1)	**<0.001**	131 (39.8)	0.521
Yes (n=80)	29 (36.3)		35 (43.8)	
Know aim of drug use				
Yes (n=333)	52(15.6)	**0.027**	126 (37.8)	**0.018**
No (n=76)	20 (26.3)		40 (52.6)	
Know most of the side effects				
Yes (n=79)	13 (16.5)	0.765	21 (26.6)	**0.005**
No (n=330)	59(17.9)		145 (43.9)	

409 subjects who used at least one drug per day were evaluated, f Row percentage, Chi-square test

Table 5— Factors Affecting Potentially Inappropriate Drug Use and Medical Non-adherence Concerning Logistic Regression Analysis.

Variables	Potentially Inappropriate Drug Use			Medical Non-adherence	
	OR*	95% CI	p	OR*	95% CI p
Polymorbidity					
No	**1**				
Yes	**2.84**	**1.55-5.20**	**0.001**		
Polypharmacy					
No	**1**				
Yes	**2.21**	**1.16-4.19**	**0.016**		
Know aim of drug usage					
Yes	1			1	
No	1.72	0.92-3.20	0.089	1.59	0.95-2.67 0.076
Know most of the side effects					
Yes				**1**	
No				**1.96**	**1.12-3.41 0.018**

*Odds Ratio, the groups indicated as 1 signify the reference groups, CI indicates confidence interval.

usage of NSAIDs, digoxin and non-dihydropyridine group calcium-channel blockers in older adults seems deficient. It has been reported that there is a lack of evidence showing benefit versus risk for using aspirin in adults >80 years of age and that SSRIs should be used with caution since they can cause hyponatremia (6). In our study, these two drugs were the most frequently used ones within the group of drugs that should be used with caution.

In a study in which the drug usage tendencies of a group of elderly people dwelling in a district in Izmir were investigated, PIDU prevalence was found to be 21.3%, with the most frequent inappropriately used drugs reported as digoxin and doxazosin (18). In a large scale study conducted by using electronic records in England and Wales, PIDU was 21.4% in the community subjects and 33.0% in the care home subjects (19). In the same study (19), the most frequent inappropriately used drugs were diazepam (4.2%), anticholinergic antihistamines (3.6%), and fluoxetine (3.4%). In the Three-City study conducted in France in which a modified form of the Beers criteria were used, 38.7% of the elderly had at least one potentially inappropriate drug usage and the most frequently (23.4%) used drug was cerebral vasodilators (20). Benzodiazepines (9.4%) were the second most frequent, and drugs with anticholinergic properties like tricyclic antidepressants (6.4%) were the third most frequently used drugs (20). In a study conducted in Poland, PIDU prevalence was 28.2% and the most frequently used drugs were chlordiazepoxide and diazepam (10.0%), long-acting benzodiazepines (7.7%) and indomethacin *(2.5%)* (21). According to a study by Roth and Ivey in 2002 involving older adults registered in the North Carolina Eldercare program, the prevalence of PIDU was 34% (13). Blalock and colleagues conducted another study in the rural part of the same area between 2002 and 2004, and found that 26.6% of older adults had at least one inappropriately used drug (22). The most frequently inappropriately used drugs were propoxyphene, NSAIDs, muscle relaxants and antispasmodics, anticholinergics, and antihistamines (22).

The PIDU prevalence in our study was lower than those found in the other studies. However it should be kept in mind that some of the studies used data from electronic health records (19). In our study we used information obtained from the older adults themselves, and the data was limited by underreporting by the subjects and recall and information bias. The differences in the results may also be related to the differences in the criteria used to determine inappropriate drug use. For example, in some studies the researchers added some items to the criteria (20) or inquired about certain drugs that were omitted from the updated version of the Beers criteria that we used (i.e. ferrous sulfate in dosages >325 mg/d, propoxyphene, fluoxetine) (18-20,22). Nevertheless, when our study is compared with the other studies, it is clear that the utilization of psychotropic drugs and anticholinergic drugs is much less frequent.

We determined that polypharmacy and polymorbidity were risk factors for PIDU. In parallel with our study, sever-

al other studies in the literature revealed that as the number of drugs used increases, the number of inappropriately used drugs also increases (19,20,22). Shah et al. (19) found that the number of comorbid conditions did not affect PIDU. On the other hand, Blalock et al. (22) found that a history of major depression, hypertension, osteoarthritis, and back problems were found to be risk factors for PIDU. Lechevallier-Michel and colleagues (20) determined that older age, being female, lower socioeconomic level, lower household income and poor health perception were risk factors for PIDU; however, we did not find any relationships with these variables. In the same study, the authors detected a significant relationship between the presence of depressive symptoms and PIDU, and explained this relationship by the fact that psychotropic drugs occupy an important portion of inappropriately used drugs (20). In our study the inappropriate use of psychotropic drugs was less than that reported in the literature. This may explain the absence of a relationship between PIDU and depressive symptoms in our group.

Medical Non-adherence

In our study the prevalence of MN was 40.6%. We determined that the most common nonadherent behavior components were "forgetting to take the medication" and carelessness in taking the drug on time. In two different studies conducted in USA in which the same scale was used, MN prevalence was found to be 53% by Roth and Ivey and 41% by Sirey et al. (13,14). Consistent with our study, in Sirey et al.'s study (14) the most common non-adherent behavior was also "forgetting to take medication" (33%).

Solmaz and Akin (23) investigated adherence to medication dosage in addition to the MN criteria. They determined MN in the elderly living at home as 77% (23). In the same study, the most common components of non-adherence were "stopping to take the medication when feeling better" (72.0%) and "forgetting to take medication" (70.7%) (23).

In our study the only risk factor for MN was determined to be "not knowing most of the side effects of the drug". Similarly, "not knowing the side effects of the drug" was also determined as a risk factor in Solmaz and Akin's study (23). In that study the other risk factors were "being 75 years of age and above", not having a caregiver to help with taking the medication, having moderate-severe cognitive deficits, and "not finding the information given about the drug adequate" (23). Consistent with our study, Sirey et al. (14) found that sociodemographic factors such as age, sex, education level, number of chronic diseases, presence of depression and disability, and problems with vision did not affect MN. However, difficulty in opening the medication bottle was reported as a tangible barrier (14).

In conclusion, lower prevalence rates than in most of the previous studies were detected for both PIDU and MN. Nonetheless, about one-fifth of the elderly comprising the study sample were using drugs inappropriately and about half of the sample had medication non-adherence. Older adults received health care mostly from family health centers. Therefore, physicians practicing in primary health care institutions have a particularly important responsibility for rational medication utilization in the elderly. All physicians, especially primary care physicians, should be informed about rational drug utilization during undergraduate education and post-graduate in-service training. During this training, it should be emphasized that polypharmacy should be avoided in older adults with polymorbidity; additional drugs should not be given for non-specific symptoms like drug side-effects. The drugs that are accepted as inappropriate should also be underlined. Moreover, physicians should be warned about inappropriately used drugs through electronic prescription systems. The national health care database of primary, secondary, and tertiary healthcare institutions should be integrated, so that coordinated dataflow within the health system can be achieved. By this means, all healthcare providers can reach all the information concerning the diagnosis and treatment process of the patient. Additionally, in order to decrease MN, patient-doctor communication should be enhanced and the purposes of drug utilization and particularly the possible side effects of the prescribed drugs should be explained to the patient and/or the caregiver. Elderly patients should be evaluated in regular follow-up visits to investigate the effectiveness and side effects of the drugs.

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