The Relationship of Classes of Commonly Prescribed Medications to Functional Status and Quality of Life for Frail Home-Based Older Adults

Sherrilene Classen, PhD, MPH, OTR/L
William Mkanta MStat
Kerry Walsh, BS
William Mann, PhD, OTR/L

ABSTRACT. We compared classes of medication and inappropriately prescribed medications (IPDs) (potentially not indicated for seniors) to functional status and quality of life (QOL) in 1,099 seniors. We used data from the Physical Health Measure of the Older Americans Resources and Services (OARS) instrument, Functional Independence Measure (FIM), Instrumental Activities of Daily Living (IADL) of the OARS, two QOL questions, and Beer's criteria for IPDs. Multivariate analyses show

Sherrilene Classen is Assistant Professor, Department of Occupational Therapy, College of Public Health and Health Professions, Gainesville, Florida.

William Mkanta is affiliated with the Department of Health Services Research, Management and Policy, College of Public Health Professions, Gainesville, Florida.

Kerry Walsh is affiliated with the Department of Occupational Therapy, College of Public Health and Health Professions, Gainesville, Florida.

William Mann is Professor and Chair, Department of Occupational Therapy and Director of the PhD Program in Rehabilitation Science at the Rehabilitation Engineering Research Center on Aging, Department of Occupational Therapy, College of Public Health and Health Professions, Gainesville, Florida. He is also Research Health Scientist at the Veterans Health Administration in Gainesville.

Address correspondence to: Sherrilene Classen, Department of Occupational Therapy, College of Public Health and Health Professions, PO Box 10064, Gainesville, FL 32610-0164 (E-mail: sclassen@phhp.ufl.edu).

Physical & Occupational Therapy in Geriatrics, Vol. 24(1) 2005
Available online at http://www.haworthpress.com/web/POTG

doi:10.1300/J148v24n01_02

cardiac medications positively, and analgesics inversely associated with FIM and IADLs, and endocrine medications inversely associated with FIM. Two high-risk groups emerged: older, not married (widowed, divorced and single) non-whites at risk for functional decline, and those with IPDs at risk for poorer QOL. These findings suggest research and prevention roles for rehabilitation professionals.

KEYWORDS. Classes of prescription medications, inappropriately prescribed medications, activities of daily living, instrumental activities of daily living, quality of life

BACKGROUND

In 2000, people over 65 accounted for 13 percent of the US population and consumed 31 percent of prescription medication (Federal Interagency Forum on Aging-Related Statistics, 2000). By 2010, the 65+ population is expected to double and dependence on prescription medications is also expected to increase. The 85+ group, those with the greatest medical and functional needs and with the highest use of prescription medications, is the fastest growing segment of the population (Federal Interagency Forum on Aging-Related Statistics, 2000). This shift in demographic trends requires health care providers to understand and attend to complexities of medication use.

Compared to their younger counterparts, senior adults are at greater risk for experiencing adverse outcomes (e.g., functional decline and hospitalizations) to certain medications. Internal factors (e.g., chronic and multiple diseases, physiological changes and increased over-the-counter medication use) and external factors (e.g., pharmacokinetic and pharmacodynamic interactions, and prescribing behavior of physicians) contribute to leaving this population especially vulnerable to the effects of medications. Reactions in the senior adults (e.g., dizziness, drowsiness, failure to thrive) earlier associated with other causes such as dementia or normative depopulation of brain cells are now recognized as adverse reactions to medications or certain classes of medications (Fordyce, 2004).

Currently the Food and Drug Administration requires that companies demonstrate safety and efficacy for a drug before it can be approved for marketing. Most studies adhering to these requirements are limited to

people between the ages of 20 and 60, prompting experts to call for an amendment to the Food, Drug and Cosmetic Act of 1962 to include senior adults (Avorn, Gurwitz, & Rochon, 2004). However, most existing research targets the healthy younger adult group.

Negative outcomes (confusion or falls) have led to a phenomenon known as the geriatric syndrome (Hanlon, Schmader, Ruby, & Weinberger, 2001). Teasing out the factors associated with these negative outcomes is complex. These may be provider-related (e.g., prescribing inappropriate drugs), patient-related (non-compliance), medication-related (time expired), culture and ethnic related (poverty or discrimination) or multifactorial (poor vision plus language barriers plus lack of coordination among multiple providers). Few studies (Classen, Mann, Wu, & Tomita, 2004; Hanlon, Fillenbaum, Kuchibhatla, Artz, Boult, Gross et al., 2002; Iliffe, Haines, Gallivan, Booroff, Goldenberg, & Morgan, 1991) relate medication issues to functional status, a very important area for the rehabilitation professional. Although these studies address the significance of numbers and appropriateness of medications to decreased functional status, we are not sure which classes of medications are mostly associated with functional changes.

Effects of prescription medications on function and health-related (QOL) are documented in the medical literature and summarized in Table 1. These studies did not use older adults as their subjects, nor a standard definition for functional status or QOL, and are heterogeneous in nature. For example, some studies used components of function (e.g., cognition or communication) while others used performance activities (e.g., walking or transferring) as measures of functional status. Likewise, QOL findings included a variety of patient perceptions or scores from different QOL instruments. From a rehabilitation perspective, functional status is an indicator of the client's ability to perform actions, is expressed in performance of activities of daily living (ADLs) and instrumental activities of daily living (IADLs) (Neistadt & Crepeau, 1998). QOL is the clients' self-perception on life satisfaction, often influenced by the ability to perform ADLs and IADLs independently (Clark, Azen, Zemke, Jackson, Carlson, Mandel et al., 1997; Law, Steinwender, & Le Clair, 1998). Rehabilitation professionals have not yet examined the association between classes of medications and functional status or QOL.

Beers and colleagues have identified 28 medications and categories of medications as potentially harmful, especially to senior adults, who are at greater risk for adverse effects than adults (Appendix 1) (Beers, 1997; Beers, Ouslander, Rollinger, Reuben, & Beck, 1991;

TABLE 1. Associations of classes of medications to functional status and QOL

Author (year)	Medication class	Study type (N)	Functional status	QOL
Schmader et al. (1998)	Cardiovascular	CS (520)	Positive (OR = 0.70, 95% CI = 0.49, 0.99)	N/A
Yamashita et al. (1999)		CSt (1)	Positive	N/A
Slovick et al. (1995)	Diuretics	RCT (115)	N/A	Negative**
Ried et al. (1998)	CNS	CS (4,192)	Negative	N/A
Schmader et al. (1998)	Analgesics	CS (520)	Positive (OR = 0.54, 95% CI = 0.39, 0.75)	N/A
De Sonnaville et al. (1998)	Endocrine	PC (418)	Little impact	N/A
Castaneda et al. (2000)		CS (714)	Negative**	N/A
N/A	Gastrointestinal	N/A	N/A	N/A
Eron and Passos (2001)	Antibiotics	CC (223)	Positive	N/A
Hanlon (1997)	Anti-inflammatory	PC (2,765)	Negative (β = 0.41, 95% CI = 0.08, 0.74)	N/A
Zhao et al. (2000)		RCT (1,149)	Positive**	N/A
Duthie et al. (2002)	Smooth muscle relaxants	HC (347)	Positive***	N/A
Osoba et al. (1999)	Autonomic nervous system	RCT (161)	N/A	Positive**
Lockey et al. (1999)	Respiratory tract	RCT (474)	N/A	Positive***

Legend: CC = Case control; CS = Cross sectional; CSt = Case study; HC = Historical cohort; PC = Prospective cohort; RCT = Randomized controlled trial.
*$p < .05$; **$p < .01$; ***$p < .001$; N/A: No information available.

Fick, Cooper, Wade, Waller, Maclean, & Beers, 2003; Hanlon, Fillenbaum, & Kuchibhatla, 2002; McLeod, Huang, & Tamblyn, 1997).[1] The Beers criteria, consensus criteria for detecting potentially inappropriate medication (IPDs) use in older adults, have been widely used over the past ten years for studying prescribing patterns within populations, educating clinicians, and evaluating health outcomes, cost and utilization data (Fick, Waller, & Maclean, 2001; Hanlon, Schmader, & Boult, 2002; Kaufman, Kelly, Rosenberg, Anderson, & Mitchell, 2002; Morley, 2002). Although we know that a negative

relationship exists between IPDs and health (Aparasu & Mort, 2000; Pitkala, Strandberg, & Tilvis, 2002; Schmader, Hanlon, Landsman, Samsa, Lewis, & Weinberger, 1997; Zhan, Sangl, Bierman et al., 2001) we are not sure what IPD's association is to functional status and QOL in the senior adult population.

With the growth of the senior adult population, their risk for negative outcomes from certain medications, and their being understudied as a population, the existing but limited inverse associations among aspects of medications to functional status, and the lack of clarity of how medication-related issues (classes of drugs) corresponds to QOL, the question becomes: after controlling for major predictors of functional decline (Classen et al., 2004; Stuck, Walthert, Nikolaus, Bula, Hohmann, & Beck, 1999), how are classes of medications and IPDs related to functional status and QOL in senior adults?

This study is unique in that it: (1) utilized an existing database of frail senior adults to examine classes of medication and IPD; the latter currently lacking in the geriatric rehabilitation literature; (2) after controlling for some predictors of functional decline, examined how classes of medication and IPDs relate to functional status; and (3) measured the association of classes of medication and IPDs to self-perceived QOL and life satisfaction. Findings from this study identified risks and benefits associated with classes of medication and IPDs, and laid the foundation for further hypothesis generation.

METHODS

Sample

The sample included 1,099 frail home-based older adults with at least one impairment in ADL or IADL functioning. Older adults (over 60 years) who were receiving services from a human service agency, or had been discharged from hospital rehabilitation programs, were referred by 26 service organizations (e.g., Elder Care and Area Agencies on Aging) from Western New York (WNY) and seven from Northern Florida (NFL). These hospitals and organizations mailed invitations to potential participants. Both WNY and NFL participants were also recruited using posters in service housing complexes announcing the study. The subjects who responded and who were interested in participating in this study were entered consecutively. Written informed consents were obtained from all individuals according to the guidelines of

the institutional review boards of the University of New York at Buffalo and the University of Florida.

Design

Data from the Consumer Assessment Study (CAS) (Mann, Karuza, Hurren, & Tomita, 1993) were examined cross-sectionally. We evaluated classes of prescription medications and IPDs, the independent variables, on two dependent variables: functional status and QOL. We identified and controlled for six of the most significant predictors of functional decline: age, gender, race, marital, educational and cognitive status (Perry & Turner, 2001; Stuck et al., 1999; Thomas, Sweetnam, Janchawee, & Luscombe, 1999). Functional status, ADLs and IADLs, are continuous, while QOL and life satisfaction are categorical.

Instruments

We used previously administered assessments from the CAS battery (Mann et al., 1993), i.e., the CAS Demographic Information and the Physical Health measure of the Older Americans Resources and Services (OARS) instrument, to identify age, gender, race, education and marital status as confounding variables. Existing cognition data, obtained from the Mini Mental Status Examination (MMSE), were treated as continuous variables (range 0-30; scores 23 and less indicate cognitive impairment).

We used question six of the Physical Health questionnaire of the OARS, adjusted to include number and type of prescription medications, for the medication data. These data were divided into the 13 classes of medications, derived from combining the classes from the American Hospital Formulary Service Drug Information Guide (AHFS) (Hooper, 1997) with the "Classes of Prescription Drugs Commonly Used by Medicare Patients" (Bottomley & Lewis, 2003). Two categories, "other" and "not defined" were also included: "other" represented non-prescription medications and "not defined" represented those with data errors. An IPD, one of the 28 medications or classes of medications determined and described by Beers (Beers, 1997; Beers et al., 1991) (Appendix 1), was designated to one of the classes of medication (Table 2B).

The Functional Independence Measure (FIM), used to determine ADL status, consists of 18 items, each with a maximum score of seven and a minimum score of one (range 8-126). The FIM measures

self-care, sphincter control, mobility, locomotion, communication and social cognition. Since the FIM measures unidimensional and linear subscales we used the FIM Motor (range 13-91) and the FIM Cognitive scores (range 5-35) (Pollak, Rheault, & Stoecker, 1996). This instrument demonstrates sound psychometric properties as evidenced by high test-retest reliability for 45 repeated FIM assessments for the motor (ICC = .9) and cognitive subscales (ICC = .8); and high construct validity, using one way ANOVA for FIM ratings for the three groups, showing significant differences for both the motor subscale, $F(2,46) = 34.71$, $p < .05$, and the cognitive subscales, $F(2,46) = 12.42$, $p < .05$ (Pollak et al., 1996). This instrument, also demonstrating hierarchical levels of item difficulties, is credible in measuring severity of disability in senior adults (Enright, McBurnie, Bittner, Tracy, McNamara, Arnold et al., 2003; Njegovan, Hing, Mitchell, & Molnar, 2001).

The IADL of the OARS, measures instrumental activities of daily living with seven items and determines the participant's ability to use a telephone, get to places out of walking distance, shop, prepare meals, do housework, take medicine and handle money. Responses are scored 2 = without help, 1 = some help, 0 = completely unable or no answer. The IADL score ranges from 0 to 14 with 14 indicating the highest level of independent functioning.

Two QOL questions (Rehabilitation Engineering Research Center on Aging Center for Assistive Technology Handbook, 2000) were used to determine QOL and life satisfaction. The QOL question asked, "how has the quality of your life been during the past four weeks?" and the life satisfaction question, "how satisfied are you with life in general?" Respondents rated the QOL question on a five-point scale with "1" indicative of QOL being very well and "5" very bad. Life satisfaction is rated on a four-point Likert-type scale with "4" being very satisfied and "1" not satisfied. Although these questions are not justified with validity or reliability measures, Carr, Higginson, and Robinson (2003) suggest that a self-rated QOL questionnaire, as is the case with these questions, is predictive of self-perceived QOL.

Data Collection and Data Management

Occupational therapists and nurses who received training on interview, self-report, and observation methods according to the CAS study protocol (Rehabilitation Engineering Research Center on Aging Center for Assistive Technology Handbook, 2000) collected data. They administered in-home structured interviews and observations, which lasted an

average of 2.5 hours (rest-breaks included), on subjects in WNY and NFL. Medications were recorded via client self-report and verified by observations. The FIM, IADL of the OARS, and the two QOL questions were obtained from self-report. The data were stored in a password-protected computer and server network. No identifiers (e.g., name, birth date, social security number) were included and each subject's data were organized using a subject number. To enhance the precision of the medication data, we matched each medication with one of the thirteen pre-determined classes. Medication type by generic name and class were cross-referenced with the Clinical Pharmacology 2000 database for accuracy. We consulted with a pharmacologist to further ensure accuracy of interpretation. In consultation with a statistician, the data were checked for entry errors, data duplication and for missing data points. Protocol for handling these issues can be obtained from the first author *(sclassen@phhp.ufl.edu).*

Data Analysis

We used SPSS 11 (SPSS for Windows, 2001) to analyze the data in three stages. In the first stage we calculated descriptive statistics for the demographic characteristics, confounding variables, medications and the dependent variables (functional status and QOL). These statistics included means, standard deviations, percentages and range of scores. In the second stage, controlling for collinearity, we used bivariate analyses to examine the relationship between the independent variables (classes of medications and IPDs) and the dependent variables. We used Chi-square to compare classes of prescription medication and the two QOL questions, and linear regression to compare the independent variables to FIM motor, FIM cognitive and IADL of the OARS. Similarly, we conducted bivariate analysis on the subgroup of clients who were identified as having IPDs.

In the third stage, we used the strength of bivariate associations to conduct multivariate analyses (multivariate linear regression for the continuous dependent variables and multinomial logistic regression for the categorical dependent variables). Using the "enter" mode in regression the exploratory model expressed, in the presence of the confounding variables, the associations between classes of medications and the dependent variables. According to the distribution of the demographics in Table 2, and for the purpose of analysis, we converted the variables race, level of education and marital status into indicator (dummy) variables.

RESULTS

Table 2A presents the number, percent, mean values and standard deviation for distribution of demographics, medications, chronic conditions and cognition. The subjects were predominantly female (73%) and white (80%) with a mean age of 75.34 years. Slightly more than half were living alone and the majority had attained educational levels less than high school. The average number of medications was 5.41 (*SD* = 3.78), chronic illnesses 8.15 (*SD* = 5.42) and MMSE scores 20.74 (*SD* = 10.90). Table 2B presents the number and percentage of medications by class and IPDs. Cardiovascular medications were used the most (72%), while cancer medications were used the least (1.70%). Twenty-five percent had IPDs with central nervous system (CNS) drugs showing the highest frequency (37%). We detected no inappropriate prescriptions for antibiotics or cancer medications.

Table 3A presents the distribution of the FIM and IADL of the OARS. The mean scores were: FIM motor 74.80 (*SD* = 15.10), FIM cognitive 31.54 (*SD* = 6.22) and IADL of OARS 8.40 (*SD* = 4.00). Table 3B presents the distribution of the QOL and life satisfaction. The majority of the subjects (72.20%) indicated having a good, or equally good and bad QOL; while 70.80% report more satisfied than not or very satisfied with life. We performed a means procedure (t-test) between those subjects with and without QOL data, using age, MMSE scores and FIM Total. No significant differences existed between those with and those without QOL scores.

From bivariate analyses we determined that cardiac, analgesics, endocrine, diuretics and CNS classes were significantly associated with the dependent variables. Table 4 presents the linear regression of classes of medication, and six confounding variables, to the FIM motor and cognition, and the IADL of the OARS. The use of cardiac, analgesic and endocrine classes significantly predicted FIM motor scores. Subjects using cardiac medications were likely to have an addition of 3.05 points in FIM motor score, while those using analgesics and endocrine were likely to have a decrease of 2.33 and 2.19 points respectively on the same score. FIM cognitive scores were positively associated with cardiac, diuretic and CNS classes of medications, and inversely associated with analgesics and endocrine classes. The IADLs of the OARS was positively predicted by cardiac classes and inversely predicted by analgesics. Aging of the subjects was associated with decreased FIM and IADL scores. The largest effect was observed in the FIM motor score, in which each year of age increase, over 60, was associated with a 0.15

TABLE 2. Demographic characteristics, medications, chronic illnesses, and cognition

A: Demographics	
Age, mean (SD)	75.34 (8.41)
Gender	
Male	297 (27.00%)
Female	801 (73.00%)
Race	
Black	201 (18.30%)
White	883 (80.35%)
Other	15 (1.35%)
Living status	
Living alone	587 (53.40%)
Living with someone	509 (46.60%)
Level of education completed	
Less than high school	674 (61.40%)
Some college	243 (22.10%)
Bachelor's degree	99 (9.00%)
Masters degree	52 (4.70%)
Doctorate	21 (1.90%)
Marital status	
Married	346 (31.50%)
Widowed	533 (48.50%)
Divorced	114 (10.40%)
Single	88 (8.00%)
Number of medications, mean (SD)	5.41 (3.78)
Number of chronic illnesses	8.15 (5.42)
Mini mental status score	20.74 (10.87)

B: Medications by class and inappropriately prescribed class

Class of medications	Prescribed n = 1,099	Inappropriately prescribed n = 275
Cardiovascular	788 (71.70%)	89 (32.40%)
Gastrointestinal	454 (41.30%)	6 (2.20%)
Anti-inflammatory	451 (41.00%)	12 (4.40%)
Endocrine	409 (37.20%)	2 (0.01%)
Diuretics	360 (32.80%)	1 (0.00%)
Vitamins and minerals	353 (32.10%)	3 (1.10%)
Central nervous system	346 (31.50%)	102 (37.00%)
Analgesics	282 (25.70%)	9 (3.30%)
Respiratory tract	175 (15.90%)	10 (3.60%)
Antibiotics	136 (12.40%)	0 (0.00%)
Autonomic nervous system	78 (7.10%)	102 (37.00%)
Smooth muscle relaxants	30 (2.70%)	12 (4.40%)
Cancer	19 (1.70%)	0 (0.00%)
Not defined	22 (2.00%)	—
Other	122 (11.10%)	—

TABLE 3. Distribution of the response variables

A: FIM and IADL of the OARS by number, range, mean, and SD

Instrument	N	Range	Mean	SD
FIM Motor	1,099	13-91	74.80	15.01
FIM Cognitive	1,099	5-35	31.54	6.22
IADL of the OARS	1,099	0-14	8.40	4.00

B: QOL and Life Satisfaction by category, frequency, and percent

Category	Frequency	Percent
QOL, N = 870		
Pretty bad or very bad	77	7.00
Equally good and bad	247	22.50
Very well or pretty good	546	49.70
Life Satisfaction, N = 876		
Not satisfied	98	8.90
More satisfied than not or fairly well satisfied	489	44.50
Very satisfied	289	26.30

decrease in the score on the average. In all three models non-whites and not married subjects (widowed, divorced and never married) were inversely associated with the scores. On the average, compared to white (married) subjects, a non-white (not married) subject had a decrease of 2.24 (4.09) on FIM motor, 1.02 (1.65) on FIM cognitive and 0.62 (0.91) on the IADL of the OARS. Compared to those who had less than high school education, those with at least some high school education were associated with higher scores in all three models. Further analysis showed that those with IPDs had an inverse association with QOL and life satisfaction, meaning that senior adults with increased IPDs were associated with poor QOL ($p < 0.05$) and low satisfaction with life ($p < 0.05$).

Multinomial logistic regression showed that, from all the variables entered into the model, only marital status was associated with QOL. Compared to those who were married, the not married subjects who had "pretty bad or very bad" QOL were 2.5 (95% *CI* = 1.29-5.03) times more likely to attain "very well" QOL. No significant associations were found among classes of medication and life satisfaction, or the five confounding variables. However, the results show that subjects who were

TABLE 4. Linear regression of classes of medication and six confounding variables to FIM motor, FIM cognitive and IADL of OARS scores (*N* = 1,099)

Variable	β	SE (β)	p
FIM Motor			
Cardiac	3.05	1.00	0.00
Analgesics	−2.33	1.03	0.02
Endocrine	−2.19	0.94	0.02
Age	−0.15	0.06	0.01
Male gender	0.77	1.00	0.48
Non-whites	−2.24	1.16	0.05
Some high school	3.75	0.93	0.00
Not married	−4.09	1.06	0.00
Cognition (MMSE)	0.12	0.04	0.03
FIM cognitive			
Cardiac	2.23	0.39	0.00
Diuretic	0.73	0.38	0.05
Central nervous system	1.38	0.38	0.00
Analgesics	−1.02	0.41	0.01
Endocrine	−1.24	0.37	0.00
Age	−0.08	0.02	0.00
Male gender	−1.15	0.42	0.00
Non-whites	−0.12	0.45	0.79
Some high school	1.73	0.36	0.00
Not married	−1.65	0.41	0.00
Cognition (MMSE)	0.16	0.02	0.00
IADL of OARS			
Cardiac	1.20	0.24	0.00
Analgesics	−0.52	0.25	0.03
Age	−0.04	0.01	0.00
Male gender	0.86	0.26	0.00
Non-whites	−0.62	0.28	0.03
Some high school	1.00	0.22	0.00
Not married	−0.91	0.25	0.00
Cognition (MMSE)	0.15	0.01	0.00

"not satisfied" were less likely to become more satisfied or very satisfied with life, as they age (*OR* = 0.96, 95% *CI* = 0.94-0.99). Cognition was positively associated with those being "more satisfied than not or fairly well satisfied" (*OR* = 1.02, 95% *CI* = 1.02-1.03).

DISCUSSION

Compared to the 65+ population, subjects in this study were older, a greater number were female and a lower proportion still married. Their race, living status and level of education were comparable to all people over 65 (U.S. Census Bureau, 2004). Although the frequencies of the classes of medications used in this study differed from those reported in another study (Ray, Thapa, & Shorr, 1993), they were consistent with epidemiological data for chronic diseases requiring such medications. In this study, medications most used were cardiovascular, gastrointestinal and anti-inflammatories. Not surprising since the prevalence of cardiovascular disease is 50 percent in the 65+ age group (Centers for Disease Control and Prevention, 2005a), while the prevalence of arthritis is 50 percent in the 65-75 group, 70 percent in the 75+ age group (Centers for Disease Control and Prevention, 2005b). Although 50-60 percent of all cancers are found in the 65+ group (Centers for Disease Control and Prevention, 2005a), and cancer is the second most common cause of mortality in persons 65+ (Balducci & Lyman, 1997), only 2% of subjects used cancer medications. This is perhaps reflective of the typically short-term use of these drugs, or perhaps that terminally ill cancer patients have already died and their data are therefore not reflected in the study. The scores on the functional status instruments demonstrated that the subjects were fairly independent in their motor and cognitive performance, and about average in their IADL performance. For QOL and life satisfaction, the majority of the subjects reported an above average score.

Classes of cardiac medications showed positive associations to motor performance, IADLs, and cognition and are supported by existing studies (Yamashita, Miyagawa, Inagaki, & Dohi, 1999; Schmader, Hanlon, Fillennbaum, Huber, Pieper, & Horner, 1998). Although Unosson, Ek, Bjurulf, and Larsson (1991) demonstrated that diuretics were inversely associated with ADLs, we found a positive association to cognition. In contrast to a previous study (Ried, Johnson, & Gettman, 1998), our study showed a positive association of CNS medications to cognition. This was surprising, especially because 102 subjects received inappropriately prescribed CNS medications. Subjects taking analgesics demonstrated an association with decreased motor and IADL performance. These findings may be influenced by the limitations on motor performance inflicted by chronic pain conditions; or be associated with side effects such as dizziness, confusion and delirium from postural hypotension and dehydration, which impair cognitive

functioning (Schmader et al., 1998). Male subjects, those with (at least) some high school, and those with higher cognitive levels were associated with increased independence in IADLs. Consistent with the literature, those groups who were older, not married (widowed, divorced or never married) and non-white had a greater likelihood to perform poorer on their IADLs (Berkman & Glass, 2000). Lack of sensitivity of the IADL of the OARS (Doble & Fisher, 1998) could have influenced the results.

Castaneda, Bermudez, and Tucker (2000) found a decreased association between endocrine and functional impairment in the Hispanic population. These findings support ours; however, ours were not limited to Hispanics. The negative association of these classes to cognitive performance may be partially explained by the hypoglycemic responses, e.g., impaired judgment and confusion, elicited by these medications (Ray, Gurwitz, Decker, & Kennedy, 1992).

The non-whites (compared to whites) were more likely to report satisfaction with life, a finding that is unexpected and not typical of current literature on minority QOL issues (Berkman & Glass, 2000). Furthermore increased cognition was associated with increased life satisfaction. For subjects taking IPDs, preliminary findings on having poorer QOL and life satisfaction, suggest a need for further research.

LIMITATIONS

Limitations included bias (due to design or self-report), e.g., memberships, interviewer, Berkson and recall bias, which may have added systematic error to the data. Response rate and interrater reliability were not available. The quantity of statistical tests could have increased the likelihood of chance findings. The data set did not reflect the most recent changes in clinical practice guidelines. We accounted for classes of prescription medications used in the month prior to the interview and do not have data to support compliance, usage patterns (actual vs. prescribed intake), or taking over-the-counter medications, herbs or dietary supplements. The odds ratios could, therefore, have been over or underestimating the true situation. We analyzed data from a large sample resulting in small clinically significant differences. Effects of underlying medical conditions, long-term use of medications and interaction effects were not accounted for. To establish a temporal sequence among those classes with apparent inverse associations, potential confounders, underlying medical conditions, and functional status, a longitudinal study is indicated. Based on the third revision of the Beers criteria (Fick

et al., 2003), and the significance of IPDs to QOL in this study, we suggest prospective examination of the effect of IPDs to functional status.

CONCLUSION

This exploratory study related classes of medications and IPDs to functional status and QOL in home-based senior adults. Analgesics and endocrine classes were associated with functional decline, but clinical differences were small. We observed the emergence of two high-risk groups: for functional decline, those who were older, not married (widowed, divorced, or single), and non-white; and for poorer QOL and life satisfaction, those with IPDs. These findings suggest further prospective investigation and clinical practice opportunities. Rehabilitation professionals must know what medications their senior adult clients are taking; familiarize themselves with IPDs; discern with their clients the potential impact of medications on functional status; and suggest approaches to offset the adverse effects of medication. These approaches may include the use of safety devices, cognitive aids, services for independent medication management, consultation with the primary care physician, and caregiver/family education. Assuming such functions adds a research and illness/injury prevention role for rehabilitation professionals working with older adults.

NOTE

1. Since the completion of this study the Beers criteria for inappropriate medications were revised in December 2003. See article: Fick, D.M., Cooper, J.W., Wade, W.E., Waller, J.L., Maclean, R., & Beers, M.H. Updating the Beers criteria for potentially inappropriate medication use in older adults: Results of a US consensus panel of experts. *Arc Int Med*, 2003; 163: 2716-2724.

AUTHORS' NOTES

The authors thank the following faculty and staff at the University of Florida: Christopher L. Sistrom, MD, for assisting with the database development; Craig Velozo, PhD, and Dave Angaran, BS, MS in Pharmacy, for their comments and insights; the Research Science Doctoral students, Michael Justiss and Dennis McCarthy, for their assistance with the data retrieval and Sandra Winter for proofreading.

The first author completed this project as a Post-Doctoral Fellow funded by grant #UF 3303473-11. Data was collected through funding from the National Institute on Disability and Rehabiliation Research of the Department of Education under grant #H133E60006 for the Rehabilitation Engineering Research Center on Aging. Dr. Classen presented an abstract of this paper at the International Conference on Aging, Disability and Independence in Arlington, Virginia on Saturday, December 7, 2003.

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Received: 11/15/04
Revised: 06/05/05
Accepted: 06/25/05

APPENDIX

Beers list for inappropriately prescribed medications (Adapted from Beers, 1997; Beers, Ouslander, Rollinger et al. 1991)

Propoxyphene and combination products: Darvocet
Indomethacin (Indocin, Indocin SR)
Phenylbutazone (Butazolidin)
Pentazocine (Pentazocine)
Trimathobenzamide (Tigan)
Most antispasmodic drugs, e.g., methocarbamol (Robaxin); carisoprodol (Soma) flurazepam (Dalmane); oxybutin (Ditropan); chlorzoxane (Paraflex), metaxalone (Skelaxin)
Amitriptyline (Elavil); chlordiazepoxide-amitriptyline (Limbitrol); perphenazine-amitryptaline (triavil)
Doxepin (Sinequan)
Meprobamate (Miltown, Equanil)
Large doses of benzodiazepines, e.g., lorazepam (Ativan) >3 mg/day; oxazepam (Serax), 60 mg; alprazolam (Xanax), 2 mg; temazepam (Restoril), 15 mg; zolipem (Ambien), 5 mg; triazolam (Halcion), 0.25 mg
Chlordiazepoxide (Librium); chlordiazepoxide-amitryptaline (Limbitrol), clidinium-chlordiazepoxide (Librax), and diazepam (Valium)
Disopyramide (Norpace, Norpace CR)
Digoxin (Lanoxin) over 0.125 mg daily, except when treating atrial arrhythmias
Dipyridamole (Persantine)
Methyldopa (Aldomet); methyldopa/hydrochlorothizide (Aldoril)
Reserpine (Serpasil); reserpine hydrochlorothiazide (Hydropres)
Chlorpropamide (Diabinese)
Gastro-intestinal antispasmodic drugs, e.g., dicyclomine (Bentyl); hyoscyamine (Levsin, Levsinex); propantheline (Pro-Banthine); belladonna alkaloids (Donnatal and others); and clidinium-chlordiazepoxide (Librax)
Antihistamines containing chlorpheniramine (Chlor-Trimeton), diphenhydramine (Benadryl), hydroxyzine (Vistaril, Atarax), cyproheptadine (periactin), promethazine (Phenergen), tripelennamine (PBZ, Pelamine, Triplen, and Vaginex), and dexchlorpheiramine (Polaramine)
Diphenhydramine (Benadryl)
Ergot mesyloids (Hydergine, HEA), cyclospasmol
Iron supplements > 325 mg
All barbiturates except Phenobarbital (Amobarbital, Butalbital, Methohexital, Primidone, Thiopental, and Secobarbital)
Meperidine (Demerol, Meperitab)
Ticlopidine (Ticlid)