

Psychoactive medication use, sensori-motor function and falls in older women

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- 1 A 1 year prospective study was undertaken to identify possible mediating physiological mechanisms for the association between psychoactive medication use and falls in 414 women aged 65 to 99 years (mean age 73.7 years, s.d. = 6.3) who were randomly selected from the community.
- 2 Women taking certain psychoactive medications showed impaired performance in a number of sensori-motor measures, including tactile sensitivity, lower limb muscle strength, reaction time and balance control compared with women not taking these medications. Those using psychoactive medications were also comparatively inactive—taking part in only 1.1 h of planned exercise per week compared with 2.6 h for non-users ($F = 12.44$, $df = 1,412$, $P < 0.01$).
- 3 Multiple logistic regression analysis revealed that use of long-acting benzodiazepines (OR = 7.03, 95% CI = 2.12–23.28) and antidepressants (OR = 2.84, 95% CI = 1.00–8.02) was significantly associated with multiple falls, whilst adjusting for age, other drug category use, frequency of alcohol use, and number of medical conditions. Use of any two psychoactive medications was also significantly associated with falling frequency (Chi-square = 13.91, $df = 1$, $P < 0.01$).
- 4 Path analysis revealed a significant direct association ($P < 0.001$) between psychoactive medication use and falls, and a significant indirect association mediated via reduced physiological functioning ($P < 0.001$). Postural hypotension was not significantly associated with falls (RR = 1.37, 95% CI = 0.84–2.22).
- 5 The findings suggest that psychoactive medication use may predispose older people to falling by impairing important sensori-motor systems that contribute to postural stability.

Keywords drugs utilization accidental falls aged physiology proprioception reaction time posture

Introduction

Epidemiological studies undertaken in both community and institutional settings have identified a range of interrelated physiological, health and lifestyle factors that increase the risk of falls in older people [1–9]. In those studies that have adjusted for the effects of medical conditions and other possible confounding factors, psychoactive drug use has been found to pose an independent risk factor for falls. In studies undertaken in the community, Cumming *et al.* reported significant associations between benzodiazepine use and falls when adjusting for other drug

category use, age, medical conditions, depression and dementia [5] whilst Tinetti *et al.* found that use of psychoactive drugs was associated with falls after adjusting for the effects of both depression and dementia [1]. Granek also found that the association between the use of psychoactive medications and falls in nursing home patients was independent of diagnosis [6].

Despite the use of psychoactive medications having been consistently linked with increased risk of falls, there has been little work undertaken in determining

the physiological mechanisms by which such an association is mediated. In a series of experimental trials, Swift *et al.* have found that benzodiazepines impair reaction time and postural sway in elderly people [10, 11]. In a previous case-control study of factors associated with injurious falls we also found associations between psychoactive medication use and quadriceps strength, postural sway and two clinical balance measures: static and dynamic balance [12].

In this paper, we develop and expand on this research by evaluating whether psychoactive medications contribute to falling because they reduce postural stability, or whether they have a direct effect on falls. The roles of other factors that have been implicated with falls such as inactivity, postural hypotension and age are also examined.

Methods

Subjects

The sample comprised women aged 65 years and over who have taken part in the Randwick Falls and Fractures Study which is aimed at elucidating physiological, health and lifestyle factors associated with falls and fractures in older women [13]. The women, who were living in private households, were recruited from randomly selected Australian Bureau of Statistics collectors districts in the Randwick local government area, in Sydney, Australia between 1988 and 1991. All women aged 65 years and over living within these districts were invited to take part in the study. The only exclusion criteria were not living at the dwelling at the time of the study or having no or very little English. Informed consent was obtained from all subjects prior to interview.

Seven hundred and four women participated in the initial phase of the study, that is, they completed a structured interview containing questions about falls frequency and related health and lifestyle factors and of these, 414 undertook a comprehensive balance assessment at the University of New South Wales. The age distributions of the study population who underwent the balance assessment and the women aged 65 years and over in the reference local government area [14] are shown in Table 1. A full description of the sample characteristics and recruitment

procedures for the Randwick Falls and Fractures study has been reported elsewhere [13].

Medication, health and lifestyle measures

At the initial interview (which was carried out in the subjects' homes), the names of all currently used medications were transcribed from the medication containers directly to the coding form by the interviewer. Psychoactive medications were classified into three major groups: hypnotics, of which benzodiazepines comprised the great majority, antipsychotics and antidepressants. Benzodiazepines were further categorised into long- and short-acting groups [15] and antidepressants were classified into tricyclics and other (non-tricyclics) groups. The doses of the medications were not recorded.

Physical activity was measured as the number of self-reported hours of exercise per week, including organised sports, activities and planned walks. Alcohol consumption was measured in terms of frequency of drinking, i.e. comparing those who drank alcohol every day with those who did not drink and those who drank alcohol less often. Cognitive status was assessed with the short portable mental status questionnaire [16]. Medical conditions were assessed on a scale whereby one point was given for each medical diagnosis. The scale was constructed on the basis of a physician's examination and the structured interview. Cardiovascular, respiratory, gastrointestinal, musculoskeletal, thyroid and neurological diseases and cancer were counted. The number of medical conditions were then classified into three groups: none, 1–2 and 3–5.

Falls follow-up procedure

In 1989 we gained sufficient resources to conduct a prospective arm of the study. Thus we were able to follow up the 373 subjects who undertook the balance tests from that point on for a period of 1 year to determine whether certain physiological, health and lifestyle factors were associated with falls. A fall was defined as an unexpected loss of balance resulting in the person coming to rest on the ground or floor, not as the result of a major intrinsic event such as a stroke, or an overwhelming hazard. Questionnaires regarding falls frequency and sequelae were mailed to residents every 2 months (with a reply paid envelope). If subjects failed to return their questionnaire, further contact was made by telephone interview.

Three hundred and fifty subjects were followed up for a full year (93.8%), 12 died (3.2%), seven moved out of the area or to a nursing home (1.9%), and four withdrew consent (1.1%). Four subjects who died or were admitted to a nursing home part way through the 12 month follow-up period fell two or more times whilst in the study. These subjects were included in the prospective results. Finally, after excluding 13 further subjects who scored three plus errors on the mental status questionnaire, so as to minimise under-reporting of falls by those with cognitive impairments [16], 341 subjects were included in the prospective analysis.

Table 1 Number and percentage in each age-group: study sample and Randwick local government area (LGA)

Years	Study sample	Randwick LGA
65–69	133 (32.1)	2835 (30.0)
70–74	98 (23.3)	2269 (24.0)
75–79	114 (27.5)	1964 (20.8)
80–84	47 (11.4)	1328 (14.1)
85+	22 (5.3)	1043 (11.0)
Total	414 (100.0)	9439 (100.0)

Sensori-motor function and blood pressure assessments

Twelve tests of sensori-motor function, balance control and postural hypotension, comprising measurements of peripheral sensation, strength, reaction time, postural sway, balance and systolic blood pressure were administered to the subjects. The experimenters who administered the tests were blind to the drug use status of the subjects.

Three measures of peripheral sensation were made: tactile sensitivity at the ankle (assessed using a Semmes-Weinstein Pressure Aesthesiometer) [17], vibration sense at the knee (assessed using an electronic device which drove a 200 Hz vibration of varying intensity), and proprioception, which was tested using an apparatus which measured any error in matching the position of the lower limbs (measured in degrees). Quadriceps and ankle dorsiflexion strength were tested in the sitting position in the subjects dominant (stronger) leg. Reaction time was assessed with a simple reaction time task, using a light as the stimulus and depression of a switch (by the hand) as the response.

Body sway was measured using a swaymeter that measured displacements of the body at the level of the waist in 30 s periods. Sway was measured under four test conditions: eyes open—firm surface (a linoleum covered floor); eyes closed—firm surface; eyes open—compliant surface (high density foam rubber 70 cm by 62 cm by 15 cm high); and eyes closed—compliant surface. Total sway (number of square millimetre squares traversed by the pen) in the 30 s periods were recorded for the four test conditions. Subjects who could not perform the sway tests on the foam because of poor balance were given scores equal to three standard deviations above the mean score for these measures.

The Static Balance Test measured the ability of subjects to maintain balance while standing on a firm and a compliant surface. Subjects were classified into 5 grades—from 'Grade 1'—unable to maintain balance for any period without support on a firm surface to 'Grade 5'—capable of maintaining balance whilst standing on the floor and the foam (eyes open and closed) for 30 s periods without difficulty [18]. The Dynamic Balance Test assessed subject's ability to maintain balance whilst walking on the spot for 1 min with the eyes closed. Subjects were also classified into five grades—from 'Grade 1'—which indicated that the subject's balance was so poor that the test could not be administered to 'Grade 5' which indicated that the subject could perform the task with no difficulty maintaining good balance [18]. The grade scores in the two tests were then summed to give a composite clinical balance control score.

In previous studies we have found that impaired performances in these sensori-motor and balance tests are significantly associated with falling in community-dwelling and institutional populations of older people [12, 19, 20]. Full descriptions of the apparatus, the test-retest reliability, practice effects and the number of measures made in each test have been reported elsewhere [18, 21].

Postural hypotension Systolic blood pressure was measured in the supine position after a 5 min rest, then after 1 min in the upright position. Any change in systolic blood pressure was recorded, with a drop of 20 mm Hg pressure or more recorded as a significant drop.

Statistical analysis

The data were analysed using the SPSS [22] and Epi Info [23] computer packages. Analysis of variance was used to assess differences in the means of hours of physical activity and the sensori-motor and sway test measures between the psychoactive medication user and non-user groups, whilst controlling for the effects of age. For variables with right skewed distributions (such as the proprioception, vibration sense, reaction time and sway measures) logs of variables were analysed.

Log-linear models were used to assess the associations between psychoactive drug user status and the three clinical measures of balance (static balance, dynamic balance and the composite score). In these analyses, static balance scores were collapsed into three grades (1–3, 4 and 5), whilst the composite balance scores were collapsed into five grades (2–6, 7, 8, 9 and 10). Models with all two-way interactions: balance measure * falls, balance measure * age and falls * age were compared with models that differed only in that they omitted the balance measure * falls effects. Changes in the likelihood-ratio Chi squares (or partial Chi squares) were then assessed for significance.

The associations between the use of psychoactive medications and multiple falls in the follow-up year (two or more falls vs nil or one) were assessed using the relative risk statistic whilst adjusting for age within 10 year age-groups using the Mantel-Haenszel method. Multiple logistic regression was then performed to determine the individual contributions of the specific drug classes most strongly associated with falling, whilst simultaneously adjusting for the effects of several possible confounding variables.

Finally, a path analysis was conducted to evaluate the relative importance of psychoactive drugs in predicting falls, and to evaluate our hypotheses about the mediating roles of stability and postural hypotension. We hypothesized that the effects of age, activity and psychoactive drugs would all be mediated by the physiological systems that contribute to stability and/or by postural hypotension. Further we hypothesized that psychoactive drugs would be significantly associated with falls, independent of age and physical activity. The measure of 'instability' was derived from the first principal component of the factor analysis of the following sensori-motor and balance variables: tactile sensitivity, vibration sense, quadriceps strength, reaction time, sway on the compliant (foam rubber) surface with eyes open and the composite clinical stability score—this factor was the only factor extracted with an eigen-value greater than 1. The path analysis was conducted by analysing the polychoric correlation matrix of the five variables: psychoactive drugs (nil, one or two), age (years),

activity (hours/week), instability (principal component score) and falls (non-multiple vs multiple fallers) using the maximum likelihood method of estimation in SPSS Lisrel 7 [24]. Polychoric correlations were used to adjust for the non-normal distributions of the ordinal variables included in the model [25]. The major benefit of the path analysis is that it provides estimates of the relative importance of factors associated with falls, and a means for testing hypotheses about mediating variables.

Results

Associations between psychoactive medication use and age and sensori-motor function

The mean age of the 338 women taking nil psychoactive medications was 73.7 years (s.d. = 6.3), which was lower than the mean ages of the 64 women taking one psychoactive medication (75.6 years, s.d. = 6.1) and the 12 women taking two psychoactive medications (75.5 years, s.d. = 6.0) ($F = 4.44$, $df = 2, 413$, $P < 0.05$).

Table 2 shows the mean scores plus standard deviations for the peripheral sensation, strength, reaction time and sway measures for those taking nil, one and two psychoactive medications. Those taking one or more psychoactive medications performed poorly in the tests of tactile sensitivity, vibration sense, quadriceps and ankle dorsiflexion strength and sway on the compliant (foam rubber) surface with

eyes open compared with those taking no psychoactive medications. When comparing those who were taking two psychoactive medications with those taking nil or one, dual users performed significantly worse in the tests of quadriceps and ankle dorsiflexion strength, reaction time and sway on the firm surface with eyes open. After controlling for age, significant associations remained between psychoactive drug use (one or more drugs) and tactile sensitivity and quadriceps and ankle dorsiflexion strength. Further, the use of two plus medications (vs nil or one), was associated with significantly poorer performances in the tests of quadriceps and ankle dorsiflexion strength and reaction time.

Psychoactive medication use was also significantly associated with static and dynamic balance in bivariate analyses, although only dynamic balance retained significance after adjusting for age (partial $\chi^2 = 4.72$, $df = 2$, $P = 0.09$ and partial $\chi^2 = 12.56$, $df = 4$, $P < 0.05$ respectively). A strong significant association was also found between the sum of the grades in these two tests and psychoactive medication use (partial $\chi^2 = 15.82$, $df = 4$, $P < 0.01$).

With regard to psychoactive drug sub-classes, there were significant associations (after controlling for age) between use of: benzodiazepines and dynamic balance (partial $\chi^2 = 15.89$, $df = 4$, $P < 0.01$); long-acting benzodiazepines and tactile sensitivity ($F = 7.62$, $df = 1, 413$, $P < 0.01$), static balance (partial $\chi^2 = 7.20$, $df = 2$, $P < 0.01$) and dynamic balance (partial $\chi^2 = 12.21$, $df = 4$, $P < 0.05$); nitrazepam and sway on the compliant (foam rubber) surface with eyes closed ($F = 5.32$, $df = 1, 413$, $P < 0.05$);

Table 2 Psychoactive drug use and sensori-motor function

	<i>Nil (n = 338)</i> <i>Mean (s.d.)</i>	<i>One (n = 64)</i> <i>Mean (s.d.)</i>	<i>Two (n = 12)</i> <i>Mean (s.d.)</i>	<i>Total (n = 414)</i> <i>Mean (s.d.)</i>
<i>Peripheral sensation</i>				
Proprioception ^a	1.94 (1.63)	1.85 (1.41)	2.19 (1.32)	1.93 (1.59)
Touch ^b	4.09 (0.43)	4.25 (0.56)*	4.17 (0.28)	4.11 (0.45)
Vibration sense ^c	21.6 (20.0)	28.0 (26.6)	32.5 (26.1)	22.9 (21.5)
<i>Strength</i>				
Quadriceps strength/ht ^d	12.7 (4.5)	11.4 (4.7)*	9.2 (3.0)†	12.4 (4.5)
Ankle strength/ht ^d	3.6 (1.0)	3.3 (1.0)*	2.9 (1.0)†	3.5 (1.0)
<i>Reaction time^e</i>	250 (56)	257 (56)	288 (60)†	252 (56)
<i>Sway^f</i>				
Eyes open (floor)	81 (43)	88 (48)	128 (141)	83 (49)
Eyes closed (floor)	115 (61)	117 (67)	123 (57)	116 (62)
Eyes open (foam)	132 (65)	147 (74)	169 (71)	136 (67)
Eyes closed (foam)	234 (109)	237 (127)	262 (103)	235 (112)

Significant difference between psychoactive drug use (0 vs 1+ drugs) after controlling for age.

* $P < 0.05$.

Significant difference between psychoactive drug use (0, 1 vs 2 drugs) after controlling for age.

† $P < 0.05$.

^aDegrees difference.

^b \log_{10} 0.1 mg pressure.

^cMicrons of motion perpendicular to body surface (peak to peak).

^d(kg/m).

^eMilliseconds.

^fMillimetre squares traversed by pen on swaymeter in 30 s.

diazepam and static balance (partial $\chi^2 = 6.42$, $df = 2$, $P < 0.01$); temazepam and dynamic balance (partial $\chi^2 = 15.44$, $df = 4$, $P < 0.01$); oxazepam and static balance (partial $\chi^2 = 6.40$, $df = 2$, $P < 0.05$) and anti-depressants and quadriceps and ankle dorsiflexion strength ($F = 4.30$, $df = 1,413$, $P < 0.05$ and ($F = 5.49$, $df = 1,407$, $P < 0.05$ respectively).

Psychoactive drugs and postural hypotension

Twenty-one of the 66 subjects taking one or more psychoactive medications had a postural systolic blood pressure drop of 20 mm Hg or more at assessment, compared with only 62 of the 302 subjects not taking psychoactive medications (RR = 1.60, 95% CI = 1.01–2.53). Those who recorded a 20 mm Hg pressure or more blood pressure drop, however, were not at significantly increased risk of falling (RR = 1.37, 95% CI = 0.84–2.22).

Psychoactive drugs and physical activity

Sports and activities participated in by the subjects included planned walks, bowls, swimming, aerobics/exercises, golf, tennis, bicycling and dancing. Those taking one or more psychoactive medications were comparatively inactive (in that they took part in only 1.1 h of planned exercise per week on average)—considerably less than the average of 2.6 h for those not taking psychoactive medications. The associations between inactivity and the use of one or more psychoactive drugs, and the psychoactive drug classes:

short- and long-acting benzodiazepines retained significance after controlling for age in ANOVA procedures ($F = 12.44$, $df = 1,412$, $P < 0.01$, $F = 7.07$, $df = 1,412$, $P < 0.01$ and ($F = 3.97$, $df = 1,412$, $P < 0.05$ respectively).

Psychoactive drugs and falls

Sixty-five of the 341 women available to follow-up were taking one or more psychoactive medications (sedatives, anti-anxiety agents, anti-psychotics and anti-depressants) at assessment. Twenty-three of these women (35.4%) suffered multiple falls in the follow-up year, compared with only 48 of the 276 women (17.4%) not taking psychoactive medications (adjusted relative risk = 1.93, 95% CI = 1.34–3.09). Table 3 shows the bivariate associations between particular psychoactive drugs and drug classes and multiple falls.

A significant dose response relationship was noted between psychoactive drug use and falls. Compared with those taking no psychoactive drugs, those taking one psychoactive drug had 2.08 times the risk of falling whilst those taking two plus psychoactive drugs had 8.99 times the risk of falling after adjusting for age using the extended Mantel-Haenszel method ($\chi^2 = 13.91$, $df = 1$, $P < 0.01$). All three subjects taking two benzodiazepines suffered multiple falls in the follow-up year, and of these, two were taking two short-acting medications (temazepam/oxazepam combinations). Two of the five subjects taking benzodiazepine/antidepressant combinations and one of the

Table 3 Psychoactive medications* and multiple falls

<i>Medication</i>	<i>n</i>	<i>RR†</i>	<i>(95% CI)</i>
<i>Sedatives and antianxiety agents</i>			
Benzodiazepines (short half-life)	23	0.65	(0.22–1.91)
Oxazepam	8	0.63	(0.10–4.00)
Temazepam	15	0.67	(0.18–2.48)
Benzodiazepines (long half-life)	13	3.43	(2.10–5.60)
Diazepam	5	2.07	(0.69–6.19)
Flunitrazepam	1	5.16	(4.14–6.42)
Nitrazepam	7	3.86	(2.29–6.50)
Total benzodiazepines	36	1.67	(0.96–2.89)
Total sedatives ¹ and AA‡ agents	38	1.57	(0.90–2.73)
<i>Antipsychotics</i>			
Total antipsychotics ²	2	2.57	(0.63–10.46)
<i>Antidepressants</i>			
Tricyclics ³	11	1.91	(0.85–4.30)
Total antidepressants ⁴	14	1.89	(0.90–3.95)

*Use of one psychoactive medication only vs no use.

†Adjusted for age within 10 year age-groups using the Mantel-Haenszel method.

‡Antianxiety medications.

¹Includes amylobarbitone ($n = 1$) and unspecified ($n = 1$).

²Includes thioridazine and chlorpromazine (both $n = 1$).

³Includes amitriptyline ($n = 4$), doxepin ($n = 5$), desipramine ($n = 1$) and imipramine ($n = 1$).

⁴Includes tricyclics plus mianserin ($n = 1$), tranylcypromine ($n = 1$) and unspecified ($n = 1$).

two subjects taking antipsychotic/antidepressant combinations suffered multiple falls.

The multiple logistic regression model was used to adjust simultaneously the effects of the various drug categories and possible confounders of the falls-medications relationships. The variables included were the major sub-classes of psychoactive medications of interest: short- and long-acting benzodiazepines, antipsychotics and antidepressants as well as other medications that have been implicated with falls: antihypertensives (including diuretics), analgesics and antipyretics and non-steroid anti-inflammatory drugs. Age, alcohol use and number of medical conditions were also entered into the model. The adjusted odds ratios, which are shown in Table 4, revealed that long-acting benzodiazepines and antidepressants were significantly associated with increased risk of multiple falls.

Physiological mechanisms for the association between psychoactive medication use and falls—path analytical model

Initially, a theoretical model based on all hypothesized factors involved in falls was specified. This model was similar to that shown in Figure 1, with psychoactive medications, activity and age as x variables, instability and falls as y variables and the addition of postural hypotension as a y variable. All the arrows from x to y variables were included making this a saturated model with no degrees of freedom. There were no significant effects involving postural hypotension, so this variable was deleted. The direct effect of age on falls was also non-significant so this variable was also deleted. The remaining model gave a highly acceptable solution with $\chi^2 = 0.04$, $df = 1$, $P = 0.424$ and a Goodness of Fit Index of 0.999. The effects (gammas) of the x-variables on the y-variables (instability and falls) were all significant according to *t*-tests at $P < 0.001$. The standardised solution of the path analytic model which shows the relative strengths of the effects (which are analogous to cor-

relation co-efficients) is shown in Figure 1. The direct effect of 0.19 for psychoactive medication on falls was of the same order as the indirect effect (via instability) which was 0.16.

Discussion

The findings of this large prospective study, which was conducted in a community setting, emphasise the complex interrelationships of the numerous factors involved in falls in older people. Women taking psychoactive medications showed impaired performance in a number of sensori-motor measures, including tactile sensitivity, lower limb muscle

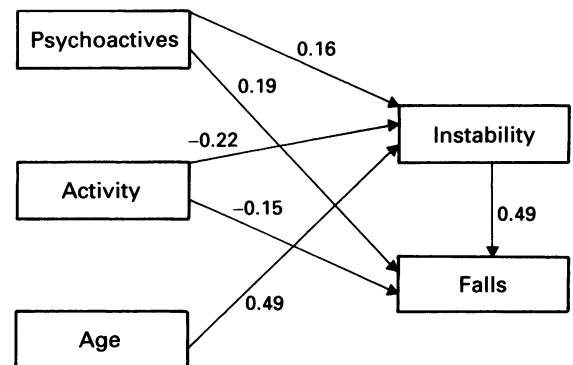


Figure 1 Path analytic model for the relationship between psychoactive medication use and falls. The standardised relative strengths of the effects are indicated by the numerals above the path arrows. Notes: Psychoactives: nil, one or two. Activity: hours/weeks. Age: age in years. Instability: principal component of the factor analysis of the following sensori-motor and balance variables: tactile sensitivity, vibration sense, quadriceps strength, reaction time, sway and clinical stability. Falls: two or more falls vs nil or one.

Table 4 Adjusted odds ratios for multiple falls for use of selected medications

Medication	Adjusted odds ratio	95% CI
Benzodiazepines (short half-life)*	0.83	0.29–2.40
Benzodiazepines (long half-life)*	7.03	2.12–23.28
Antipsychotics	1.66	0.17–16.37
Antidepressants	2.84	1.00–8.02
Analgesics and antipyretics	1.27	0.62–2.59
Antihypertensives (including diuretics)	1.42	0.56–2.04
Non steroid anti-inflammatory agents	1.07	0.78–2.59

*As indicated in Table 3.

Medication use also adjusted for age, alcohol and use and medical conditions.

Note: those with 3+ errors in the Mental Status Questionnaire were excluded from the analysis.

strength, reaction time and postural stability compared with women not taking these medications. Of particular interest, there were significant associations between benzodiazepine use and instability and antidepressant use and lower limb muscle weakness.

Psychoactive drug use was also found to be an independent risk factor for falls after adjusting for the effects of medical conditions and other possible confounding factors such as age, other drug category use and frequency of alcohol consumption. Not all psychoactive medications were, however, associated with falls, which has important implications for drug prescribing practices. The multiple logistic regression analysis revealed long-acting benzodiazepines increased falls risk, whereas short-acting benzodiazepines did not. These findings are consistent with those of Cumming *et al.* [5] and Ray *et al.* who found a similar result for the risk of hip fracture [26], and indicate that long-acting benzodiazepines, either as night sedatives or as tranquillizers, should be avoided in older people. The use of two short-acting benzodiazepines, however, or indeed any two psychoactive medications, was strongly associated with falling.

Antidepressant use was the other major psychoactive drug group that was associated with falls. This finding is consistent with a study by Ruthazer & Lipsitz [27] who found that antidepressant use increased the risk of falling whilst adjusting for the effects of previous falls, functional status and age. Davie *et al.* [28], have also reported that antidepressants, especially when combined with other hypotension-producing drugs, increase the risk of dizziness and falls. An implication for prescribing practices is that due to their association with falls, antidepressants should not be prescribed for night sedation or indications other than that for the treatment of depression.

Those taking antipsychotic medications were at increased risk of falls although the association was not statistically significant. As the study population was drawn from women living independently in the community, and as those with cognitive impairment were excluded from the prospective analysis of falls, only a small number in the study population were taking these medications. Other studies, undertaken using different samples have found that these medications are also implicated with falls [3, 6, 28].

It is acknowledged that one limitation of the study is that drug use was determined on one occasion only, at the commencement of the 1 year follow-up period, and it is possible that changes in drug use over the 12 month follow-up period may have occurred. Such changes, however, would only weaken or dilute the observed associations with sensori-motor functioning and falling. It is also acknowledged that although the study was undertaken using a large random sample of older women, the associations between certain drugs and drug classes and multiple falls should be viewed with some caution, as the numbers taking these drugs were small. Finally, as multiple statistical comparisons were made, it is possible that some of the associations may have occurred by chance.

It has been suggested that reduced mental alertness and speed of transmission within the central nervous system, sedation, blurred vision, confusion, neuromuscular incoordination and postural hypotension are mechanisms by which psychoactive medications predispose older people to falls [6, 26, 29]. We found a significant association between psychoactive medications and postural hypotension (as measured by systolic blood pressure drop 1 min after standing following a 5 min supine rest), but no significant association between postural hypotension and falls.

In contrast, there were a number of significant associations between the use of psychoactive drugs and reduced sensori-motor functioning, and reduced sensori-motor functioning and falls. The path analysis model, which adjusted for inter-related and confounding factors such as increased age and inactivity, suggests that the association between psychoactive drug use and falls is mediated, in large part, through reduced physiological functioning. Further research is required to determine if the remaining unexplained direct effect evident in the model is due to other postulated mediating factors such as reduced mental alertness and sedation.

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