Falls, medications and balance among residents in long-term care institutions

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Abstract
The aim of this study was to investigate prevalence of falls, use of medications and balance among the residents in long-term care institutions.

Methods. Every third resident from 8 long-term care institutions in Kaunas region was included in the study, totally 252 residents. Questionnaire interRAI LTCF (Long Term Care Facility) version 2006 (09) was used for the data collection.

Results. More than one quarter (28.2%) of the residents fell down during the last 30 days. Most of the residents (38.1%) were prescribed with 2–3 medications. Benzodiazepines were one of the most frequently used medications (27.0%) in our study (respectively female 30.4% and male 21.3%). Falls possibility among residents was increased by unsteady gait (OR = 9.164, p = 0.001), dizziness (OR = 13.453, p = 0.015), and difficulties move self to stand position unassisted (OR = 13.453, p = 0.008).

Conclusions. The findings support the view that falls could be avoided through rational use of drugs and appropriated management of balance in long term care institutions in Lithuania.

Key words: falls, medications, balance, long-term care institution

Introduction
Falls are common, serious, and related to mortality among older people [1]. Falls worsen the quality of life and are related to vulnerability, difficulties maintaining autonomy and independence by older people [2,3]. Individual risk factors for falls are many as high age, being a female, history of falls, balance deficit, and polypharmacy [4]. One of the most threatened consequences of falls is fractures. In a 12-year follow-up study 25% of home-dwelling persons aged 65 and older (N = 1177) sustained at least one fracture. Hip fractures were related to increased mortality [5].

Medications are important therapeutic tools in the care of older people [6]. In Finnish study (1998–2004) people 75 years and over used on average seven drugs. People in institutions used three drugs more than people living at home. Excessive polypharmacy (10+ drugs) was found in every forth older person and this amount increases with age. Polypharmacy was very prevalent in older people especially among the most vulnerable [7]. In a Canadian study people living in nursing homes commonly received nine or more drugs [8]. Polypharmacy includes many side effects, which weaken
older people’s cognitive and functional capacity [9–12]. Benzodiazepines as a group or by certain medications are associated with falls or fall-related fractures [13–16]. Sorock and the colleagues found that the risk of falls among nursing home residents significantly increased within 3 days of a central nervous system medication change [17].

In old age skeletal muscle degeneration increases the risk of poor balance mobility, and falling [18]. Muscle weakness is a significant risk factor for falls, as is gait, balance deficit and the use of an assistive device [19]. Worse functional capacity, any lower extremity disability like loss of strength, orthopedic abnormality or poor sensations as well as difficulty in rising from a chair are associated with increased risk [20–21]. Also visual problems effect on balance control [22]. Sousa with the colleagues summarized in their study that the better the balance of an aged person had, the better his functional capacity was [23]. In a Canadian study difficulties with balance and vision, appeared to be more important predictors than medications in elderly population [24].

The cause of falls is multifactorial with use of medications and impaired balance being significant risk factors. Living in institutions increases the risk of falling same as age and frailty levels do [1].

In Lithuania the definition of long-term care was formalized for the first time in the year of 2007. Long-term care was defined as an entirety of care and social services by providing which care and social needs of persons are met and continuous comprehensive help and supervision by specialists are provided [25]. Long term care institutions are affiliated to the Ministry of Social Security and Labour in Lithuania, so more attention is paid to social area.

Only few publications analyzing some topics of residents in long-term care institutions of Lithuania were published. One study found dominated high fall risk significantly among the residents older than 85 year [26], Alekna et al. (2004) investigated that in 1 year period 34.4% of residents fell at least once and 14.3% of them fell while getting out of bed [27]. In both studies fallers and elderly with high risk of falls used more medications than non-fellers and residents with medium, low risk of falls.

The aim of this study was to investigate prevalence of falls, use of medications and balance among the residents in long-term care institutions.

Methods and Materials

Study population. The data was collected in eight long-term care institutions for elderly of Kaunas Region (Lithuania) in 2009. Every third resident was included in the study, totally 252 residents, of whom 158 (62.7%) were female and 48 (37.3%) male. Mean of resident’s age was 75.41 ± 13.10 years of age. Nearly two third (63.1%) were admitted to long-term care institution from private home.

Measurements

Falls and balance. Questionnaire interRAI LTCF (Long Term Care Facility) version 2006 (09) was used for the data collection. Balance and falls were assessed according Guide for use of the interRAI LTCF Assessment Form [28]. In all long-term care institutions there were no records in documentation on resident’s falls and balance. The researcher asked staff and residents to follow falls incidents and staff made records. The information about falls was recalled from the last 30 days. Fall was defined as any unintentional change in position where the resident ends up on the floor, ground or other lower level including falls that occurred while being assisted by others.

The researcher evaluated residents balance and filled in form. Balance was assessed by four interRAI LTCF domains: 1) difficult to move self (difficult or unable to move self to standing position unassisted, 2) difficult to turn self (difficult or unable to turn self around and face the opposite direction when standing, 3) dizziness (resident experienced the sensation of unsteadiness, 4) unsteady gait (resident may appear unbalanced or walk with a sway, have uncoordinated or jerking movements, walk fast with large, careless movements, abnormally slow with shuffling steps, have a wide-based gait with halting, tentative steps).

Medications. The data on amount and the group of medications was collected from the residents’ prescription records. Polypharmacy was defined as no (0–1 medications), minor (2–3 medications), moderate (4–5 medications), severe (≥ 6 medications) [29].

Medications that may contribute to falls were classified into three groups: high risk medications (Antidepressants, Antipsychotics, Anti-muscarinic, Benzodiazepines and Hypnotics, Drugs for Parkinson’s disease), moderate risk medications (ACE inhibitors, Angiotensin II antagonists, Alpha-blockers, Anti-arrhythmics, Anti-epileptics, Anti-histamines, Beta-
blockers, Diuretics), and low risk medications (Calcium Channel Blockers, Nitrates, Opiate analgesics, Oral anti-diabetics, Proton pump inhibitors PPIs and H 2 antagonists) [30].

**Data analysis**

The analysis was carried out on SPPS version 15.0. The falls, medications and balance were examined in different gender and age groups. The age of the residents was divided into four age groups: 64 and younger, 65–74 years of age, 75–84 years of age, and 85 and older.

The statistical analyses were carried out with the use of the descriptive statistics, χ² test, z criteria. Possible independent factors were evaluated by using the multiple logistic regressions, calculating the odds ratio and 95% confidence interval. Multiple logistic regression analysis was carried out when significant differences were obtained by applying univariate logistic regression. The difference considered statistically significant when p<0.05.

**Ethics consideration**

The study protocol was approved by Kaunas Regional Bioethics Committee (No BE-2-34 and No P1-104/2008).

**Results**

**Falls.** More than one quarter (28.2%) of the residents fell down during the last 30 days (Table 1). Most of the fallers were female (39.2%) and the difference between male and female fallers was statistically significant (p < 0.001). The amount of falls increased from younger to older age groups, but the difference between the different age groups did not reach statistical significance.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-fallers, n (%)</th>
<th>Fallers, n (%)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>85(90.4)</td>
<td>9(9.6)</td>
<td>p &lt; 0.001, χ² = 25.5, df = 1</td>
</tr>
<tr>
<td>Female</td>
<td>96(60.8)*</td>
<td>62(39.2)*</td>
<td></td>
</tr>
<tr>
<td>Age group, years, n (%)</td>
<td></td>
<td></td>
<td>p = 0.429, χ² = 2.8, df = 3</td>
</tr>
<tr>
<td>≤64</td>
<td>36(76.6)</td>
<td>11(23.4)</td>
<td></td>
</tr>
<tr>
<td>65–74</td>
<td>37(75.5)</td>
<td>12(24.5)</td>
<td></td>
</tr>
<tr>
<td>75–84</td>
<td>69(72.6)</td>
<td>26(27.4)</td>
<td></td>
</tr>
<tr>
<td>≥85</td>
<td>39(65.9)</td>
<td>22(36.1)</td>
<td></td>
</tr>
<tr>
<td>Total n (%)</td>
<td>181(71.8)</td>
<td>71(28.2)</td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05 comparing to male.

**Medications and falls.** One third of the residents (31.7%) did not take any medications or took only one (Table 2). Male take one or no medications more often than female (respectively 50.0% and 20.9%) (p < 0.005). Most of the residents (38.1%) take 2–3 medications. From the female group 22.2% used 4–5 medications when as in the male group the amount was 9.6% (p < 0.005). The situation was same between female and male in the use of 6 and more medications. There were no statistically significant differences between the fallers and non-fallers when number of taken medications was examined.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of medications, polypharmacy</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Falls, n (%)</td>
<td>0–1 (no)</td>
<td>2–3 (minor)</td>
</tr>
<tr>
<td>Non-fallers</td>
<td>64 (35.4)</td>
<td>68 (37.6)</td>
</tr>
<tr>
<td>Fallers</td>
<td>16 (22.5)</td>
<td>28 (39.5)</td>
</tr>
<tr>
<td>Gender, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>47 (50.0)</td>
<td>31 (33.0)</td>
</tr>
<tr>
<td>Female</td>
<td>33 (20.9)*</td>
<td>65 (41.1)</td>
</tr>
<tr>
<td>Total, n (%)</td>
<td>80 (31.7)</td>
<td>96 (38.1)</td>
</tr>
</tbody>
</table>

*p < 0.005 comparing to male.
The most frequent prescribed medications were ACE inhibitors (for female in 48.1% cases and 17.0% in males.), and diuretics (female 23.4%, male 9.6%). Benzodiazepines were one of the most frequently prescribed medications (27.0%) in our study (female 30.4%, male 21.3%).

We compared falls and use of medications that may contribute to falls (Table 3). Residents with antidepressants, beta-blockers fell nearly three times more frequently. Benzodiazepines and hypnotics also contributed to more frequent falls among residents. Almost all risk medications (high, moderate, low risk) contributed to more frequent falls among residents.

Table 3. Distribution of residents by used medications and falls

<table>
<thead>
<tr>
<th>Risk† Group of medications</th>
<th>Residents used medications**+, %</th>
<th>Non-fallers</th>
<th>Fallers</th>
</tr>
</thead>
<tbody>
<tr>
<td>High risk medications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antidepressants</td>
<td>3.9</td>
<td>11.3*</td>
<td></td>
</tr>
<tr>
<td>Antipsychotics</td>
<td>15.5</td>
<td>19.7</td>
<td></td>
</tr>
<tr>
<td>Benzodiazepines and Hypnotics</td>
<td>23.2</td>
<td>36.6*</td>
<td></td>
</tr>
<tr>
<td>Drugs for Parkinson’s disease</td>
<td>4.4</td>
<td>12.7*</td>
<td></td>
</tr>
<tr>
<td>Moderate Risk medications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACE inhibitors</td>
<td>32.6</td>
<td>46.5*</td>
<td></td>
</tr>
<tr>
<td>Anti-arrhythmics</td>
<td>1.7</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>Anti-epileptics</td>
<td>3.9</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>Beta-blockers</td>
<td>6.1</td>
<td>16.9*</td>
<td></td>
</tr>
<tr>
<td>Diuretics</td>
<td>18.2</td>
<td>18.3</td>
<td></td>
</tr>
<tr>
<td>Low Risk medications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium Channel Blockers</td>
<td>5.5</td>
<td>12.7*</td>
<td></td>
</tr>
<tr>
<td>Nitrates</td>
<td>7.7</td>
<td>9.9</td>
<td></td>
</tr>
<tr>
<td>H2 antagonists</td>
<td>3.3</td>
<td>2.8</td>
<td></td>
</tr>
</tbody>
</table>

ACE – angiotensin-converting-enzyme inhibitor; †Risk of medications that may contribute to falls, *p < 0.05 comparing to non-fallers, z criteria was used, ** – percentage was compared with non-fallers and fallers who used those groups of medications.

Falls and balance. Falls risk was increased by unsteady gait (OR = 9.164, p = 0.001), dizziness (OR=13.453, p=0.015), and difficulties move self to stand position unassisted (OR = 13.453, p = 0.008) (Table 4).

Table 4. Odds ratio for likelihood of having falls by difficult move self to standing position unassisted, dizziness, unstable gait (multiple logistic regression)

<table>
<thead>
<tr>
<th>Balance (Independent factors)</th>
<th>B</th>
<th>OR</th>
<th>95% CI</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulties move self to standing position unassisted</td>
<td>0.909</td>
<td>2.481</td>
<td>1.044–5.895</td>
<td>0.040</td>
</tr>
<tr>
<td>Difficult / unable to turn self around and face the opposite direction when standing</td>
<td>0.039</td>
<td>1.039</td>
<td>0.432–2.501</td>
<td>0.931</td>
</tr>
<tr>
<td>Dizziness</td>
<td>2.599</td>
<td>13.453</td>
<td>1.642–110.220</td>
<td>0.015</td>
</tr>
<tr>
<td>Unsteady gait</td>
<td>2.215</td>
<td>9.164</td>
<td>2.540–33.060</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Dependent variable – falls. Age was included. OR – Odds ratio, CI – confidence interval, B – regression coefficient. The compatibility of the model with data $\chi^2 = 96.630, df = 4, p = 0.001$; the suitability of the model – the determination coefficient – R $^2 = 0.458$; the model prognosticated with 79.0% accuracy.

Discussion

Women reported having falls more often than men, which has been reported in earlier studies as well [31,32]. In our study 28.2% residents reported having falls during the last 30 days. This is less than in long term institutions in Minnesota (USA, 40.6%) and in Slovenia (38.0%) [33,34]. In our long term care institutions little attention was paid for not injured falls, falls prevention. So residents not carefully reported all not injured falls. It could be the main reason for less fall prevalence in Lithuania. Lower prevalence of falls in our study could be related with underreported falls without injuries.

Nearly 4% of falls consequences are hip fractures [35–37], and 10–25% other injuries [38]. In our study during 30 days no fractures were reported, but the staff informed about hip and other fractures that occurred previously.

Residents in long term care institutions usually have multiple medical conditions that require numerous of
medications. Residents in long term care institutions were prescribed with 7–8 medications in the USA [39, 40], 4–9 medications in Australia [32, 41], 3–6 medications in Slovenia [34], and 8–10 medications in Finland [42]. In our study residents were prescribed with 2.9 ± 2.4 medications.

Use of sedatives and hypnotics, antidepressants, and benzodiazepines demonstrated a significant association with falls in elderly individuals [43]. In our study residents who were prescribed with hypnotics, antidepressants, and benzodiazepines fell more frequently. Monitoring polypharmacy and falls of residents is important in improving residents’ quality of life in long-term care.

Tiedemann and the colleagues summarize that specific balance challenging exercise needs to be undertaken on a regular basis for a sustained period of time for a significant reduction in falls to occur [44]. Balance strengthening programs should be implemented in long-term care institutions in Lithuania, since our study found significant associations between falls and unstable balance.

Although a great deal of research into risk factors and interventions to reduce falls has been done, there are still gaps in knowledge. There is a need to present information on risk factors and interventions to reduce falls in long term care institutions in Lithuania. The Guideline for the Prevention of Falls in Older Persons, developed jointly by the American Geriatrics Society and the British Geriatrics Society [45] could be referenced implementing new preventive strategies.

**Study limitations**

The data of this study has been collected from only one large area of Lithuania, although the results give the first overview on falls, medications, and balance in long term care of elderly residents in Lithuania. In Lithuania there has been no documentation of falls in long term care institutions yet and the staff has not carefully followed all fall accidents especially for non injuries falls. In this situation it is possible that the results are partially reliable if the staff didn’t pay appropriate attention of their observations of falls.

This weakening was prevented by carefully informing the staff about the study and data collection in advance.

The researcher herself made a lot of work in collecting the data and by this way verifying the validity of the data. In the data collection parts of the Questionnaire interRAI LTCF were used and some information was collected from the residents’ prescription sheets. The methods are clear and as reliable as it is possible in this kind of study.

**Conclusions**

Almost the one third of residents had a fall during the last 30 days. Women reported more falls than men. Falls risk was increased by unsteady gait, dizziness and difficulties move self to stand position unassisted. Most of the residents used 2–3 medications, and almost all risk medications contributed to more frequent falls among residents. The findings support the view that falls could be avoided through rational use of drugs and appropriated management of balance in long term care institutions in Lithuania.

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Gyventojų griuvimų, medikamentų ir pusiausvyros vertinimas ilgalaikės globos institucijose

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Santrauka

Tyrimo tikslas – įvertinti gyventojų ilgalaikės globos institucijose griuvimų paplitimą, medikamentų vartojimą bei pusiausvyrą.


Rezultatai. Daugiau nei ketvirtadalis gyventojų (28,2 proc.) buvo pagriuvę 30 dienų laikotarpyje. Dauguma gyventojų (38,1 proc.) vartojo 2–3 medikamentus. Dažniausiai (27,0 proc.) vartojami medikamentai buvo benzodiazepiniai (atitinkamai vartojo 30,4 proc. moterų ir 21,3 vyrų). Nustatyta, kad griuvimų galimybę statistiškai reikšmingai didino netvirta eisena (GS = 9,164, p = 0,001), galvos svaigimas (GS = 13,453, p = 0,015) bei tie atvejai, kai gyventojui sunku atsistoti be kitų pagalbos (GS = 13,453, p = 0,008).

Išvados. Gyventojų griuvimų galima išvengti racionaliai skiriant medikamentus ir užtikrinant pusiausvyrą ilgalaikės globos institucijose.

Raktažodžiai: griuvimai, medikamentai, pusiausvyra, ilgalaikės prieziūros institucija