

Association between dentures and the rate of falls in dementia

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Background: Poor oral health, chronic diseases, functional decline, and low cognitive ability can increase the risk of falls in the elderly.

Objectives: The current study aimed to show the effects of oral health, diabetes mellitus (DM), hypertension (HT), heart disease, functional status, and sociodemographic factors on the risk of falls in elderly with dementia.

Materials and methods: The sample comprised 1,210 Malaysian elderly who were demented and noninstitutionalized. This study was a national cross-sectional survey entitled "Determinants of Health Status among Older Malaysians". The effects of age, ethnicity, sex differences, marital status, educational level, oral health, DM, HT, heart disease, and functional status on the risk of falls were evaluated. The multiple logistic regression model was used to estimate the effects of contributing variables on the risk of falls in samples.

Results: The prevalence of falls was approximately 17% in subjects. It was found that age (odds ratio [OR] 1.02), non-Malay ethnicity (OR 1.66), heart disease (OR 1.92), and functional decline (OR 1.58) significantly increased the risk of falls in respondents ($P < 0.05$). Furthermore, having teeth (OR 0.59) and dentures (OR 0.66) significantly decreased the rate of falls ($P < 0.05$).

Conclusion: It was concluded that age, non-Malay ethnicity, functional decline, heart disease, and oral health significantly affected falls in dementia.

Keywords: chronic diseases, dementia, fall, functional decline, oral health

Introduction

Dementia is the most common disabling disease in older people.¹ There are different types, such as Alzheimer's disease (AD), vascular dementia, dementia with Lewy bodies, and frontotemporal dementia.² Falls are common in the elderly,³⁻⁵ and can occur due to the negative effects of medications, medical conditions, poor nutrition, psychological problems, physical impairment, sensory disturbances, and cognitive impairment.⁶ Dementia increases the risk of falls in the elderly⁷ where cognitive decline^{8,9} impairs judgment, gait, and visuospatial perception, reducing the ability to recognize and avoid hazards.⁷ Furthermore, older people often suffer from chronic illnesses, including hypertension (HT), diabetes mellitus (DM), and vascular diseases.¹⁰ DM,¹¹⁻¹⁴ HT,¹⁵ and heart disease¹⁶ may increase the risk of falls in the elderly. DM is one of the most common chronic diseases in elderly¹² presenting with glucose intolerance.¹⁷ The prevalence and morbidities associated with DM are on the rise among older adults. The increased risk of falls in diabetic patients is due to dehydration,¹³ retinopathy, peripheral artery disease, peripheral polyneuropathy, cerebral vasculopathy, autonomic neuropathy, and poor muscle quality.¹¹

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Age can adversely influence the heart in older adults. Age-related changes in the cardiovascular system can occur due to the intrinsic cardiac aspects of senescence, primary cardiac disease, and the effects of comorbid conditions.¹⁸ The effects of cardiovascular problems on the greater risk of falls in the elderly are associated with intrinsic cardiac abnormalities (structure, rhythms), neurally mediated disorders, and some miscellaneous factors, such as pulmonary embolism and transient ischemic attacks.¹⁶ HT is also a condition that can strongly increase the rate of cardiovascular diseases,¹⁹ which consequently enhance the risk of falls in the elderly.¹⁵

A higher risk of falls in the elderly can be related to mobility dysfunction and balance problems. Functional decline influences mobility and balance skills in terms of time taken to complete the task measured by Get Up and Go Test (GUGT).²⁰ Oral health is also an important component of overall health, well-being, and quality of life in older individuals.²¹ Poor oral functioning can lead to systemic illnesses and life-threatening conditions in older adults.²² There is a positive relation between dental problems and the risk of falls among the elderly with dementia. Dental problems can affect postural control, which in turn increases the risk of falls.²³ Since the increased risk of falls is associated with morbidity, disability, social isolation, and lower quality of life in the elderly,³ the evaluation of correspondence factors has become a focus. This study aimed to investigate the effects of oral health, chronic diseases, functional status, and sociodemographic factors on the risk of falls in elderly with dementia.

Materials and methods

This project was registered in the National Medical Research Register (project code NMRR-09-443-4148). Approval and permission for conducting the study were received from the Ethical Committee of the Ministry of Health. This project was a national cross-sectional survey design entitled “Determinants of Health Status among Older Malaysians” carried out in cooperation with the Health Behavioral Research Institute, National Institute of Health, Ministry of Health, and Institute of Gerontology, Universiti Putra Malaysia.

The research involved 1,210 elderly with dementia who were Malaysian aged 60 years and above residing in noninstitutional places. The elderly living in institutions and bedridden were excluded. Samples represented the Malaysian population in terms of age, and were collected from Peninsular Malaysia, which was divided into four zones

of north, south, west, and central. Data were collected by trained interviewers who had prior experience as interviewers in projects conducted by the Institute of Gerontology. The average duration of interviews was about 60 minutes. In this study, the association between age, ethnicity, sex differences, marital status, educational level, DM, HT, heart disease, oral health, and functional status with the risk of falls was evaluated in respondents. Falls were defined according to the *International Classification of Diseases (ICD-9)*,²⁴ which excluded falls due to loss of consciousness, epileptic seizure, and sudden onset of paralysis, eg, stroke. History of falls referred to having had at least one fall during the day or night during the past 6 months. Subjects who had a Mini-Mental State Examination (MMSE) mark less than 26 were considered to have dementia.²⁵ The MMSE is a clinical diagnostic tool used for both research and clinical practice in neurology and psychiatry. It is also one of the most widely used screening and outcome measures in cognition assessments.²⁶

Functional status was measured by the GUGT for rising from a chair, walking 3 meters, turning, and returning to the chair. The GUGT is a reliable and validated instrument used to test balance and gait.^{4,27} Functional decline was defined as a time of completion of more than 20 seconds.²⁸ In the current study, the measurement of oral health was based on a self-report of having teeth and dentures.²⁹ DM, HT, and heart disease were assessed by physicians.

Statistical analysis

The prevalence of falls was computed for total samples with regard to their age, ethnicity, sex, marital status, educational level, oral health, functional status, DM, HT, and heart disease. Bivariate analysis was carried out to examine the relation between each variable and the risk of falls using a series of χ^2 tests. Multivariate logistic regression analysis was used to test the association between age, ethnicity, educational level, marital status, oral health, functional status, DM, HT, heart disease, and the risk of falls in elderly with dementia. Odds ratios (ORs) with 95% confidence intervals (CIs) were computed. The critical level for rejection of the null hypothesis was considered to be a *P*-value of 5%, two-tailed. All analyses were performed using SPSS version 20.0 (IBM, Armonk, NY, USA).

Results

Analysis was run on data collected from 1,210 respondents who were elderly Malaysians with dementia. The mean age of respondents was 71 years (minimum 60±7.38 and maximum

103±7.38 years). The prevalence of falls was 17% among subjects (95% CI 15.01–19.24) (Table 1). The results indicated that the risk of falls in respondents with DM (20.4%) was higher than those without DM (16.3%). Subjects with heart disease (27.4%) experienced further risk of falls compared to those without heart disease (16.2%). The risk of falls in HT samples (18.9%) was higher than normotensive samples (15.7%). The results showed that the prevalence of falls was 22.9% in subjects with functional decline and 13.6% in the subjects with normal functional status. The findings indicated that respondents without teeth (18.7%) and dentures (18.6%) had a higher fall rate compared to those having teeth (10.9%) and dentures (14.4%). It was found that the risk of falls in females (18.3%) was higher than males (14.8%). In addition, the rate of falls was 14.7% in respondents with education and 18.5% in those with no education.

The prevalence of falls was found to be as high as 19.4% in single subjects and 14.2% in married subjects. Among the samples, 13.3% of Malay and 20.2% of non-Malay ethnicities experienced falls. A series of χ^2 tests evaluated the association of each variable with the risk of falls in samples. The findings indicated that ethnicity ($\chi^2=10.20$, $P=0.001$), heart disease ($\chi^2=7.78$, $P=0.006$), functional decline ($\chi^2=14.44$, $P=0.001$), marital status ($\chi^2=5.75$, $P=0.010$), and having teeth ($\chi^2=8.50$, $P=0.002$) or dentures ($\chi^2=3.60$, $P=0.034$) were significantly associated with the risk of falls among respondents ($P<0.05$). The results indicated that DM, HT, educational level, and sex differences were unrelated to the risk of falls ($P>0.05$) (Table 2). The logistic regression analysis showed that age ($P=0.041$), ethnicity ($P=0.003$), heart disease ($P=0.011$), functional decline ($P=0.033$), and having teeth ($P=0.021$) or dentures ($P=0.021$) were significantly associated with the risk of falls in samples. It was found that age (OR 1.02, 95% CI 1.00–1.05), non-Malay ethnicity (OR 1.66, 95% CI 1.19–2.33), functional decline (OR 1.58, 95% CI 1.04–2.41), and heart disease (OR 1.92, 95% CI 1.16–3.19) significantly increased the risk of falls in subjects ($P<0.05$). The results showed that DM, HT, sex differences, marital status, and educational level were not significant predictors for the risk of falls in subjects ($P>0.05$). Having teeth (OR 0.58, 95% CI 0.37–0.91) or dentures (OR 0.66, 95% CI 0.47–0.94) significantly reduced the risk of falls (Table 3).

Table 1 Prevalence of falls among 1,210 elderly with dementia

| Falls | n | n (%) | 95% CI |
|-------|-------|-------|-------------|
| Yes | 206 | 17 | 15.01–19.24 |
| No | 1,004 | 83 | 80.76–84.99 |

Abbreviation: CI, confidence interval.

Table 2 Prevalence of falls and associations with sociodemographic factors

| | Total | n ^a | n% | 95% CI | χ^2 | P-value* |
|---------------------------|-------|----------------|-------|-------------|----------|----------|
| Diabetes mellitus | | | | | | |
| No | 993 | 162 | 16.3 | 14.14–18.74 | 2.07 | 0.092 |
| Yes | 216 | 44 | 20.4 | 15.54–26.24 | | |
| Heart disease | | | | | | |
| No | 1,114 | 180 | 16.2 | 14.12–18.44 | 7.78 | 0.006 |
| Yes | 95 | 26 | 27.4 | 19.42–37.08 | | |
| Hypertension | | | | | | |
| No | 695 | 109 | 15.7 | 13.17–18.57 | 2.13 | 0.084 |
| Yes | 514 | 97 | 18.9 | 15.72–22.48 | | |
| Functional test | | | | | | |
| <20 seconds** | 559 | 76 | 13.6 | 11.01–16.69 | 14.44 | 0.001 |
| ≥20 seconds | 389 | 89 | 22.9 | 18.98–27.31 | | |
| Teeth | | | | | | |
| No | 949 | 177 | 18.7 | 16.3–21.25 | 8.50 | 0.002 |
| Yes | 256 | 28 | 10.9 | 7.68–15.36 | | |
| Dentures | | | | | | |
| No | 753 | 140 | 18.6 | 15.97–21.53 | 3.60 | 0.034 |
| Yes | 451 | 65 | 14.4 | 11.47–17.95 | | |
| Teeth and dentures | | | | | | |
| No | 535 | 114 | 21.31 | 18.05–24.98 | 12.46 | <0.001 |
| Yes | 675 | 92 | 13.63 | 11.25–16.43 | | |
| Sex differences | | | | | | |
| Male | 438 | 65 | 14.8 | 11.82–18.47 | 2.32 | 0.074 |
| Female | 772 | 141 | 18.3 | 15.69–21.14 | | |
| Marital status | | | | | | |
| Single | 665 | 129 | 19.4 | 16.57–22.58 | 5.75 | 0.010 |
| Married | 543 | 77 | 14.2 | 11.5–17.37 | | |
| Ethnicity | | | | | | |
| Malay** | 550 | 73 | 13.3 | 10.69–16.36 | 10.20 | 0.001 |
| Non-Malay | 658 | 133 | 20.2 | 17.32–23.45 | | |
| Education | | | | | | |
| No | 775 | 143 | 18.5 | 15.88–21.33 | 2.82 | 0.054 |
| Yes | 430 | 63 | 14.7 | 11.62–18.31 | | |

Notes: *Significant at the 0.05 level using the χ^2 test; **reference group; ^anumber of subjects who reported at least one fall. Missing data reduced the number of all subjects in some variables.

Abbreviation: CI, confidence interval.

Discussion

As falls can cause much burden and cost in patients with dementia and their caregivers,^{30,31} the assessment of risk factors has been a major focus in further investigations. It has been well documented that age-related changes in the body,³² DM,^{11–14} HT,¹⁵ heart disease,^{3,16,33} functional status,²⁰ and oral health all affect the risk of falls in the elderly.

This study was designed to identify the correspondence of age, ethnicity, sex differences, marital status, educational level, functional status, DM, HT, heart disease, and having teeth or dentures with the rate of falls among Malaysian elderly with dementia. In the current study, age, ethnicity, heart disease, functional decline, and having teeth or dentures significantly affected the risk of falls. This project studied

Table 3 Prevalence of falls and associations derived by logistic regression analysis

| | B | SE | P-value* | OR | 95% CI for OR | |
|--------------------|--------|-------|----------|------|---------------|-------|
| | | | | | Lower | Upper |
| Diabetes mellitus | 0.245 | 0.208 | 0.238 | 1.28 | 0.85 | 1.92 |
| Heart disease | 0.654 | 0.258 | 0.011 | 1.92 | 1.16 | 3.19 |
| Hypertension | 0.147 | 0.168 | 0.382 | 1.16 | 0.83 | 1.61 |
| Functional test | 0.457 | 0.215 | 0.033 | 1.58 | 1.04 | 2.41 |
| Teeth | -0.531 | 0.230 | 0.019 | 0.58 | 0.37 | 0.91 |
| Dentures | -0.409 | 0.177 | 0.022 | 0.67 | 0.47 | 0.94 |
| Teeth and dentures | -0.423 | 0.162 | 0.009 | 0.66 | 0.48 | 0.90 |
| Sex differences | -0.225 | 0.185 | 0.225 | 0.80 | 0.56 | 1.15 |
| Educational level | 0.046 | 0.185 | 0.803 | 1.05 | 0.73 | 1.50 |
| Marital status | -0.104 | 0.180 | 0.562 | 0.90 | 0.63 | 1.28 |
| Ethnicity | 0.507 | 0.172 | 0.003 | 1.66 | 1.19 | 2.33 |
| Age | 0.024 | 0.012 | 0.041 | 1.02 | 1.00 | 1.05 |

Notes: *Significant at the 0.05 level using the logistic regression analysis. Hosmer-Lemeshow test, $\chi^2_6=6.56$; $P=0.584$.

Abbreviations: SE, standard error; OR, odds ratio; CI, confidence interval.

the effect of heart disease on the risk of falls in the elderly with dementia for the first time. Heart disease increased the risk of falls in subjects, which was probably due to medication use,^{34,35} sleep problems,^{36–38} and cardiac arrhythmias.³³ Medical conditions like postural hypotension as a side effect of medications and malnutrition can cause a higher rate of falls in the elderly with heart problems.³⁴ The association of heart disease with the impairment of cognition, disability, and gait disorders³⁹ potentially increased the rate of falls as well. The increased rate of falls in the elderly with DM and HT can be explained by the association of these problems with cardiovascular diseases.⁴⁰ This study was in line with other reports^{8,27,41} documenting functional decline as a risk factor for further falls in the elderly. It seems that balance problems, insufficient mobility, cognitive impairment,^{8,27} medications, orthostatic blood pressure, physical problems, psychological conditions, and vision problems⁸ enhance the risk of falls in elderly with dementia.

The increased rate of falls in samples without teeth or dentures was possibly due to the profound effects of teeth or dentures on systemic health.²¹ It has been established that having teeth or dentures affects nutrition, medical situations,^{42,43} social interactions, and morbidity rates.⁴² Therefore, the correlation between oral health and the risk of falls may depend on disturbance levels in food intake, masticatory ability, and behavioral and psychological status.⁴⁴

The results showed that DM and HT had no significant effects on the risk of falls in respondents, which is probably associated with the confounding effects of heart disease, functional decline, and sociodemographic factors.

Contrary to some reports,^{45–47} our study showed that ethnicity could affect the risk of falls.^{7,8,48} Such a discrepancy was possibly due to differences in lifestyle, cultures, and predisposition.⁴⁹ Indeed, lifestyle, cultural, economic, and environmental factors in a specific ethnic group are related to expression of variances in such diseases as hypertension, stroke, and ischemic heart disease, which in turn may enhance or attenuate the risk of falls.

Our study was a confirmation of previous reports indicating the presence of a link between age and the risk of falls.^{7,50–52} Such a relation can be due to age-related changes in gait, vision, memory, strength and physiological systems,^{8,48,53,54} which potentially predispose the elderly with dementia to a higher risk of falls. The findings showed that marital status, educational level, and sex differences were unrelated to the risk of falls in respondents. It is important to note that our results confirmed an earlier finding⁵⁵ contrary to reports indicating the effects of sex differences on the risk of falls.^{7,8,56} Our study did not confirm the presence of correlation between the risk of falls and marital status⁷ or educational level.^{7,8,53,57} The lack of such relevance can be related to the possible effects of confounding factors, such as social supports,⁵⁸ income,⁵⁹ supplement intake,⁸ sleep problems,^{30,60,61} environmental conditions,^{62,63} functional decline, heart problems, and oral health, which may affect the rate of falls. These factors may correlate with the physical, psychological, and cognitive changes in the patients with dementia. Therefore, the reduction of attention, cognition, mood, and motor performances can increase the risk of falls in dementia. An appropriate environment helps to overcome deficits in physical fitness and cognitive abilities posed by dementia, and thus reduces the risk of falls in elderly patients with dementia. Therefore, these factors can interact between physical activity and cognition when considering the risk of falls in respondents.⁵

Conclusion

This study faced some limitations. One problem was related to difficulty in collecting accurate self-reported data about the rate of falls and oral health from elderly with dementia, which can cause bias. Furthermore, the higher prevalence of comorbidities in these patients can limit such studies. The cross-sectional design of the study was another restriction factor that made it difficult to find the exact effective and noneffective factors. Accordingly, more standardized interviews and definitions are needed for further investigations about falls in dementia. However, this study could highlight some risk factors contributing to the risk of falls in elderly with dementia. It was concluded

that age, non-Malay ethnicity, heart disease, and functional decline increased the risk of falls in respondents. On the other hand, having teeth or dentures decreased the likelihood of falls. As falls can cause much burden, morbidity, and mortality among those patients, more studies are required to find ways to prevent and reduce the rate of falls. Furthermore, such data can help caregivers to reduce the risk of falls and unhappiness in such patients. In addition, this knowledge can provide an opportunity for policy makers and health care professionals to introduce suitable interventions in order to control the rate of falls among elderly with dementia.

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Disclosure

The authors report no conflicts of interest in this work.

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