JGG 2018;66:134-141

ORIGINAL INVESTIGATION

Health status and functional profile at admission to nursing homes A population based study over the years 2003-2014: comparison between people with and without diabetes

A.K. Sigurdardottir[1 2], K. Ólafsson[3], R.H. Arnardottir[1 2 4], I. Hjaltadottir[5 6]

[1] School of Health Sciences, University of Akureyri, Solborg v/Nordursloð, Akureyri, Iceland; [2] Akureyri Hospital, Eyrarlandsvegi, Akureyri, Iceland; [3] School of Humanities and Social Sciences, University of Akureyri, Solborg v/Nordursloð, 600 Akureyri, Iceland; [4] Uppsala University, Department of Medical Sciences, Respiratory-, allergy- and sleep-research, Akademiska Sjukhuset, Uppsala, Sweden; [5] School of Health Sciences, University of Iceland, Reykjavik, Iceland; [6] Landspítali the University Hospital of Iceland, Hringbraut, Reykjavik, Iceland

Background & Aims. Prevalence of diabetes in adults has been increasing in the last decades. Diabetes increases demand for nursing homes admission which is expensive for public and private finances. The aims of the study were to examine the prevalence of diabetes at admission to nursing homes in Iceland over 12 years, and to compare overall health, functioning, medication and medical diagnosis of residents with diabetes to those without diabetes.

Methods. A retrospective study of data obtained from the Minimum Data Set records at admission to nursing homes in Iceland during the years 2003-2014. Statistical analysis was carried out using a Chi-square-test, unpaired Student´s t-test, linear regression and logistic regression.

Results. In total 5242 residents were assessed within 180 days from admission, 730 had diabetes (13.9%). Prevalence of diabetes increased from 9.4% in 2003 to 15% in 2014, with a peak of 19.1% in 2013. Mean age was 81.0 (SD 8.2) and 82.7 (SD 8.7) years for residents with and without diabetes, respectively ($p < 0.001$). Comorbidities like hypertension, congestive heart-failure, kidney-failure, arthritis, ulcers and amputations were more common among residents with diabetes, whereas cognitive diseases were more common in the other group.

Conclusions. The prevalence of diabetes in Icelandic nursing homes is increasing. Residents with diabetes are younger and have better cognitive performance, but suffer more physical disability and serious comorbidities than others. Nursing homes' staff need to be current in diabetes management to provide quality care.

Key words: Diabetes, Nursing homes, Health status, Minimum Data Set

INTRODUCTION

The epidemiology of diabetes is shifting toward older age, with the prevalence of diabetes being highest in the population ≥ 60 years [1 2]. Diabetes increases demand for nursing home admission [3 4] which is expensive in terms of public and private finances. In United States in the year 2002 the prevalence of diabetes in nursing homes (n = 548,572) was 26.4% [5], but in the years 2011-2012, (n = 229,283) the prevalence was 35.4% [6]. In Europe, in a sample of 59 nursing homes in seven countries (n = 4037), the prevalence was estimated at 21.8% in the year 2009 to 2011 [7].

Physical disability and dementia are characteristics that affect admission to nursing homes [3 8] but this is also true for diabetes. Diabetes has been associated with risk of several, common clinical conditions of the geriatric population, such as functional decline, physical

Received: May 11, 2018 - Accepted: September 03, 2018

Correspondence: Arun K. Sigurdardottir, School of Health Sciences, University of Akureyri, Solborg v/Nordursloð, Akureyri, Iceland - E-mail: arun@unak.is

disability, falls, fractures, cognitive impairment and depression [9], apart from the traditional long-term complications such as cardiovascular and renal diseases. This has been further shown in a systematic review and meta-analysis, where the authors found that diabetes enhanced deficits in mobility, as instrumental activities of daily living and activities of daily living (ADL) [10].
People admitted to nursing homes with diabetes have more comorbidities compared to other nursing homes residents, such as cardiovascular and kidney diseases [5 7]. Diabetes treatment can be complicated in elderly persons, and the treatment of the disease presents additional challenges when symptoms of both hyper- and hypoglycaemia can be present [9] and may need to be managed.
Because diabetes is an increasing problem in nursing homes [6] and is associated with escalating burden of care [5], there is a need to recognise the scope of diabetes-related health issues of people with diabetes when admitted to nursing homes. The aim of this study was to examine the prevalence of diabetes at admission to nursing homes in Iceland over 12 years, as well as to compare health, functioning, medication use and medical diagnosis of residents with diabetes to those without diabetes.

MATERIAL AND METHODS

Subjects

All admitted residents to nursing homes in Iceland during the years 2003-2014, who were assessed by the Minimum Data Set instrument (MDS) within 180 days from admission.

Design and data

A retrospective, descriptive study of data from the Minimum Data Set (MDS) instrument, which is a part of the Resident Assessment Instrument (RAI) and routinely assessed in clinical work at nursing homes. The RAI is designed to rate functioning and health care needs of nursing home residents [11], it is based on observation, clinical documentation and interviews with residents and or their family members. The MDS assessment was originally designed as a clinical tool intended to improve care but has also been used internationally for research purposes [11]. The MDS instrument is considered a reliable and valid instrument [12] and adequate inter-rater reliability (Kappa > 0.6) has been reported for 85% of the MDS data elements [13]. Since year 2003 all nursing homes in Iceland have been required to assess residents with the MDS instrument at admission and thereafter at least 3 times a year. The MDS is then used as a basis for funding for the nursing home [14].
For this study, data from the MDS for all nursing homes in Iceland conducted in the years 2003 through 2014 was obtained. The data set contains information on 8191 individuals but only MDS assessments completed within 180 days from admission were used. This applies to 5,242 assessments or 64% of all admission assessments for individuals in the dataset.
The MDS for nursing homes version 2.0, has 21 sections with about 350 clinical data elements and six scales. All six scales are used in this analysis (Tab. I).
In addition to the six measurement scales a further 29 medical conditions were reviewed. These include both diagnosed medical conditions, such as hypothyroidism and clinically relevant incidences, such as falls in past 30 days.

Statistical analysis

Data analysis was performed using descriptive statistics (mean, standard deviation, percentages) and inferential statistics. Significant difference ($\alpha = 0.05$) between the background characteristics of the two groups (with and without diabetes) was tested using the unpaired Student´s t-test and the chi-squared test, respectively, according to the nature of the data in question. To estimate differences between the two groups in the scores of the six assessment-scales, a linear regression analysis was performed, controlling for the effect of age and gender. To estimate differences between the groups on medical conditions and clinically relevant incidences, a binary logistic regression was applied, also controlling for the effect of age and gender.

Ethical considerations

This research project was approved by the Icelandic National Bioethics Committee (VSNb2013030008/03.15), the Data Protection Authority of the Icelandic Ministry of Justice (2013030392HGK) and the Icelandic Directorate of Health (1303070/5.6.1/gkg).

RESULTS

Over the studied 12 years, the number of individual MDS admission assessments analysed was 5,242, whereof 730 residents were recorded as being diagnosed with diabetes, or 13.9%. In this cohort of new admission, 42% of the individuals were admitted from their homes, but 35.2% of the new admissions came from hospitals. Women made up 60% of these new admissions during the years 2003-2014. The mean age for all residents at admission over the 12 years varied from 82.2 to 83.9 years (Tab. II).
The proportion of residents with the diagnosis of diabetes at admission increased significantly over the

Table I. Overview of the six MDS sclaes, names, scoring of the scales and properties.

Name of scales	Scoring of scales	Properties
The ADL (Activities of Daily Living) long scale	Scores 0-28 Higher score indicates greater need for assistance [12]	The ADL scale is sensitive to change [15]
The CHESS Scale (Changes in Health, End-stage disease and Signs and Symptoms)	Scores 0-5 0, stable health, 5, unstable health, risk of mortality, hospitalization, pain, caregiver stress and poor self-rated health [16]	The CHESS Scale is a strong predictor of mortality [16]
The CPS (Cognitive Performance Scale)	Scores 0-6 0, cognitively intact 6, severe cognitive impairment [17]	The CPS correlates moderately well with the Mini-Mental State Examination [17]
The DRS (Depression Rating Scale)	Scores 0-14 0, no indication of depression 3, mild depression 14, very severe depression [18]	The DRS scale is reported to have excellent sensitivity and acceptable specificity [18]
The ISE Scale (Index of Social Engagement)	Scores 0-6 0, severe withdrawal from social engagement 6, considerable initiative and participation in social activities [12]	Score 0-2 indicates low social engagement, compared to scores 3-6 which demonstrate better social engagement [12]
The PS (Pain Scale)	Scores 0-3 0, no pain 3, severe (horrible /excruciating) pain [19]	The PS scale is valid in detecting pain in nursing home residents [19]

research period, from 9.4% in the year 2003 to 15% in 2014, with a peak of 19.1% in 2013 (Fig. 1).
More women than men were admitted to nursing homes in the studied period, but among the residents with diabetes, the gender ratio was nearly equal (Tab. III).

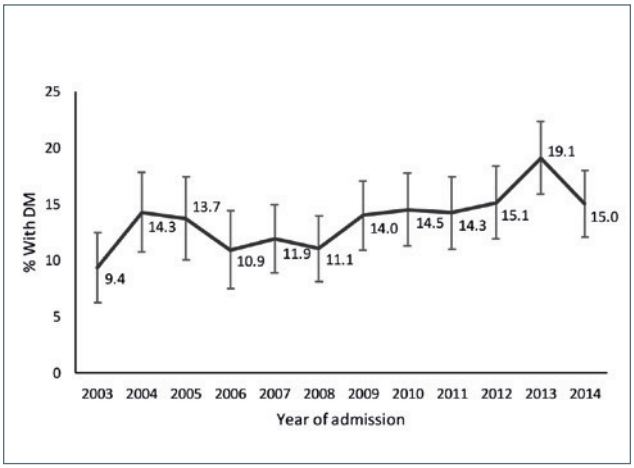

Figure 1. Prevalence (%) of diabetes at admission to nursing homes according to years 2003- 2014, Y = 10.3 + 0.50X ($p < 0.001$, for an overall increase in diabetes).

Residents with diabetes were younger at admission and the proportion of residents at the age of 75 years or younger was higher in their group than in residents without diabetes. Those with diabetes also had higher BMI and used more medications compared to residents without diabetes. A vast majority of residents with diabetes used more than nine medications (Tab. III).

Comorbidities

Newly admitted nursing home residents with diabetes had increased odds of having comorbidities as arteriosclerotic heart disease, hypertension, congestive heart disease, peripheral vascular disease, amputation, kidney failure, but less odds of having osteoporosis compared to new residents without diabetes (Tab. IV). There was no difference between the two groups (with and without diabetes) in cerebrovascular accidents as stroke, hemiparesis or TIA, but diabetes increased the risk of kidney failure by 24% and bladder incontinence by 14%. Residents with diabetes had more skin problems as ulcers, and almost double the risk of being admitted with stage 3 ulcers compared to other residents. Pressure ulcers were also more common in the group with diabetes at admission, that is 11% compared to

Table II. Number of admissions to nursing homes according to year, gender distribution, age at admission (mean and standard deviation) and where from the new residents were admitted.

Year	Admission (n =)	Admission (%)	Women (%)	Mean age (SD), years	Living at home (%)	Admitted from a hospital (%)
2003	342	6.5	56.7	82.7 (6.9)	45.3	33.6
2004	371	7.1	56.8	81.6 (7.9)	42.3	36.4
2005	335	6.4	60.3	81.2 (8.0)	49.9	33.4
2006	311	5.9	61.4	81.9 (7.8)	49.8	29.3
2007	437	8.3	57.0	82.8 (7.8)	48.5	35.5
2008	443	8.5	62.1	82.5 (8.6)	37.5	38.8
2009	493	9.4	57.8	82.3 (8.6)	39.8	33.3
2010	455	8.7	58.0	82.8 (8.7)	38.9	32.3
2011	449	8.6	58.4	82.5 (9.2)	39.4	38.1
2012	482	9.2	62.4	82.7 (8.4)	35.5	40.2
2013	565	10.8	54.9	83.1 (8.6)	43.7	36.8
2014	559	10.7	56.5	83.0 (8.9)	39.5	32.0
Total	**5,242**	**100**	**58.4**	**82.5 (8.4)**	**42.0**	**35.2**

Table III. Number of residents, mean age, percentage admitted at or below 75 years, gender distribution, Body Mass Index, use of medications and percentage of residents using nine or more types of medications in residents with and without diabetes over the years 2003-2014, at admission to nursing homes.

	With DM (n = 730)	Without DM (n = 4512)	Total (n = 5242)	P-value*
Age (years) at admission (mean and SD)	81.0 (8.2)	82.7 (8.4)	82.5 (8.4)	< 0.001
Admitted ≤ 75 years (%)	19.9	15.3	16	< 0.001
Women (%)	50.8	59.6	58.4	< 0.001
Body Mass Index (mean and SD)	26.1 (6.7)	23.8 (5.6)	24.1 (5.8)	< 0.001
Medications (mean and SD)	11.6 (4.0)	9.5 (4.1)	9.8 (4.2)	< 0.001
Using ≥ 9 medications (%)	91.1	75.5	77.7	< 0.001

*p-value for difference between groups obtained with a t-test for age, BMI and number of medications but a Chi-square test for % admitted ≤ 75 years, women and using 9 or more medications.

9% in the group without diabetes. Fewer residents with diabetes were diagnosed with Alzheimer disease and osteoporosis than those without diabetes. No difference was found between the groups regarding medical diagnoses of depression, falls or fractures in the last 180 days (Tab. IV).

MDS Scales

The scores from the six MDS- scales are shown in Table V. There was a significant difference between the groups in the CHESS-, CPS- and ISE-scales, revealing that residents with diabetes had significantly more unstable health status (CHESS-scale), but less cognitive impairment (CPS-scale) compared to residents without diabetes and were capable of more social engagement (ISE) than the latter group. The scores from the DRS-scale, the ADL-long scale and the Pain-scale demonstrated no difference between residents with and without diabetes (Tab. V).

DISCUSSION

Our findings over the studied 12 years demonstrate that the prevalence of diabetes has increased in nursing homes in Iceland, similar to other countries [6 7]. Although our results show a lower prevalence rate than observed in many other countries, the upward trend is the same. A study from US claims that over a period of 10 years the prevalence of diabetes in nursing homes increased from 16.3% in 1995 to 23.4% in 2004 [20]. Others report 26.4 to 35.4% prevalence of diabetes in nursing homes in US, using data from the MDS instrument [5, 6]. In Norway, however, the prevalence of diabetes in 19 randomly selected nursing homes was assessed to be 16% in 2012 [21], which is quite similar to the prevalence found in Iceland in the current study. However, a study found that medical diagnosis of diabetes was documented for 75% of residents with diabetes in medical records in eight nursing homes in Norway, but the

Table IV. Comparisons of residents with and without diabetes at admission, percentage, odds ratio and p-values.

	With DM (n = 730)	Without DM (n = 4512)	OR*	P-value*
Hyperthyroidism	1	1	1.37	0.40
Hypothyroidism	13	10	1.54	< 0.001
Arteriosclerotic heart disease	40	27	1.86	< 0.001
Arrhythmias	31	26	1.40	< 0.001
Congestive heart failure	32	19	2.20	< 0.001
Hypertension	65	47	2.31	< 0.001
Peripheral vascular disease	12	7	1.84	< 0.001
Other cardiovascular disease	19	14	1.51	< 0.001
Alzheimer disease	23	28	0.80	0.02
Cerebrovascular accident [stroke]	19	17	1.03	0.76
Hemiparesis	8	7	1.02	0.90
TIA	5	5	0.87	0.47
Amputation	2	0	4.85	< 0.001
Arthritis	43	38	1.35	< 0.001
Osteoporosis	15	22	0.70	< 0.001
Kidney failure	17	8	2.36	< 0.001
Depression	38	36	1.08	0.36
Falls in past 30 days	19	18	1.06	0.56
Hip fractures in past 180 days	3	4	0.80	0.30
Other fractures	4	5	0.87	0.46
Ulcers stage 1	16	10	1.59	< 0.001
Ulcers stage 2	14	11	1.34	0.01
Ulcers stage 3	3	2	1.77	0.01
Ulcers stage 4	1	0	2.23	0.07
Pressure ulcers	11	9	1.30	0.04
Bladder incontinence	79	75	1.27	0.01
Bowel incontinence	59	56	1.09	0.31
Urinary tract infections past 30 days	16	16	1.10	0.39
Respiratory infections	5	4	1.24	0.25

* Odds Ratio and p-value obtained with a binary logistic regression measuring the effect of diabetes while controlling for age and gender.

medical diagnoses was documented in medical records for all residents with diabetes in four nursing homes in Iceland [22]. The increased diabetes prevalence in nursing homes in Iceland is in line with the results from a recent study that shows that the prevalence of type 2 diabetes among Icelanders aged 50-69 increased rapidly during the first decade of this millennium, especially among males [23]. The higher prevalence of diabetes found among middle-aged and elderly males, compared to women in the study by Andersen et al. [23] probably explains the difference in gender distribution between the two groups in our results.

In the current study, residents with diabetes were younger, had higher BMI and used more medications than their counterparts. The BMI in our residents with diabetes was considerably lower than the mean BMI of 30.0 kg/m^2 in 81,087 nursing home residents with diabetes in the US as reported by Zarowitz et al. [6]. That reflects the difference in BMI between the two nations on the whole [24]. Diabetes is a predictor of early nursing home admission [4] and this was clearly reflected in our results. The Icelandic residents with diabetes in our study were slightly younger than found in European nursing homes in 2009-2011, where Szczerbinska et al. [7] reveal residents with diabetes to be on average 82.3 years and those without diabetes to be 84.6 years. In the US, the mean age of residents with diabetes is found to vary, from being reported by Resnick et al. [25] to be 81.7 years and 84.9 years for those without diabetes in the year 2004, to the results of Zarowitz et al. [6] who found that residents with diabetes were on average 75.7 years in the years 2011 and 2012. Zarowitz et al. [6] also report in their recent study that 20% of nursing homes residents with diabetes in US are younger than 65 years and Dybicz et al. [26] demonstrate that residents with diabetes are younger males with increased

Table V. Mean score and standard deviation (SD) of rating scales; activity of daily living (ADL), Changes in Health, End-stage disease and Signs and Symptoms (CHESS), cognitively performance scale (CPS), depression rating scale (DRS), index of social engagement (ISE) and pain scale (PS), according to residents with and without diabetes, over the years 2003-2014.

	With DM (n = 730)		Without DM (n = 4512)			
Scale	Mean	SD	Mean	SD	B*	P-value
ADL [0-28]	14.3	8.2	14.0	8.5	0.1	0.69
CHESS [0-5]	1.9	1.4	1.7	1.4	0.2	<0.001
CPS [0-6]	2.8	1.7	2.9	1.8	-0.2	0.03
DRS [0-14]	2.0	2.6	2.1	2.6	-0.2	0.10
ISE [0-6]	2.6	2.0	2.5	2.0	0.2	0.03
Pain [0-3]	1.2	1.0	1.1	1.0	0.1	0.17

* Mean difference estimated with linear regression, controlled for age and gender.

BMI. The results in our study are quite concurrent with the findings of these two studies. Luppa et al. [3] demonstrated through a systematic review of 36 studies regarding factors predicting admission to nursing homes that diabetes, high number of medications and impaired ADL increase the risk of admission. Younger diabetic residents can be expected to have complex physical problems, with heavy care burden, indicating the need to try to prevent development of diabetes and its complications.

Our results from the CHESS scale confirmed that residents with diabetes had more unstable physical health condition compared with other residents. This was supported by the findings that the residents with diabetes had more comorbidities, and were more than two times likely to have hypertension and congestive heart failure than other new residents. Russell et al. [27] estimate that diabetes alone is responsible for 52.1% of nursing home admissions, and diabetes plus related cardiovascular conditions are responsible for 57.1% of nursing home admissions. Dybicz et al. [26] and Zhang et al. [20] report heart and circulatory comorbidities to be the most common diseases in residents with diabetes. Our findings that no difference was demonstrated in cerebrovascular accidents as stroke, hemiparesis or TIA in residents with and without diabetes are in conflict with the results from Dybicz et al. [26]. The lack of difference in cerebrovascular accidents between the groups in our material, in spite of higher prevalence of hypertension among those with diabetes, might indicate that modern treatment with blood pressure lowering medication is effectively protective, although information regarding blood pressure measurement is lacking in the MDS data base.

Kidney failure, skin problems as ulcers, and amputations are more common in Icelandic new residents with diabetes compared to new residents without diabetes, similar to other studies [5 26]. No newly admitted resident was found to have a stage 4 ulcer, but one third of new residents with diabetes had ulcers at stages 1 and 2, and 3% at stage 3, which is higher than in the study by Feldman et al. [28]. Using the MDS instrument to assess 302 residents with diabetes, Feldman et al. [28] found 10.8% ulcers at stages 1 and 2 and 3% had infected wounds. Pressure ulcers were 1.3 times more common in the Icelandic residents with diabetes than in the residents without diabetes. To prevent skin and foot problems and if they occur, early and aggressive treatment should be undertaken. Residents with diabetes commonly have peripheral neuropathy and or peripheral arterial disease, as here, contributing to foot ulcers or infections [29].

At admission the Icelandic nursing home residents with diabetes used slightly more medication than Travis et al. [5] report in a study from US, where the mean medication use was 10.9. Our results confirm the results by others [5 26], that residents in nursing homes with diabetes use more medication compared to those without diabetes. Medication that induces hypoglycaemia has been associated with increased emergency department visits [30] and hypoglycaemia is found to be common in nursing homes [31]. Among older people with diabetes, symptoms of both hyper- and hypoglycaemia have often changed with ageing and cognitive impairment makes recognizing and interpreting symptoms even more challenging [9]. Administrating many medications can be burdensome both for the resident and the staff and the risk for drug interaction increases. Therefore, careful attention must be paid to adapt medication use to the requirement of each resident.

The CPS scale scores revealed a better cognitive functioning of the residents with diabetes, supported by the fact that fewer in that group were diagnosed with Alzheimer disease. Although the difference in ADL performance was not significant between the groups, the level of impairment was considerable, which is in

line with the findings of Zarowitz et al. [6]. No difference was found between residents with and without diabetes according to medical diagnoses of depression or scoring of the depression rating scale (DRS), which is not in agreement with the study by Travis et al. [5], who found that more residents with diabetes (30%) were diagnosed with depression compared to those without diabetes (27.5%), using MDS data.

Diabetes in nursing home residents might be more difficult to manage because of their complex health status as found here. Evidence-based guidelines [9 32] for frail old people with diabetes highligth the importance of individual treatment goals for blood glucose measurements and regulation. Regular assessment of HbA1c is also emphasized and recommendation for HbA1c treatment goals, in frail old people with diabetes [32], has also changed in recent years. This fact requires good interprofessional cooperation and knowledgeable staff. Also, the increasing prevalence of diabetes in nursing homes indicates need for qualified staff that is knowledgeable in caring for residents with unstable health conditions and able to address the residents' special needs [33].

There are several limitations of this study. Firstly, this is a retrospective analysis of data that were collected for clinical use. The MDS instrument has been deemed a valuable resource for research [34] and has moderate to high reliability as a research tool [13]. In addition, the MDS scales have shown to be valid and reliable in research [34]. However, many factors outside the scope of this study, such as staffing and staff mix may have influenced the quality of the MDS assessments and may therefore be considered a limitation. As we acknowledge this limitation, it must also be clarified that the instrument comes with a detailed manual and all the registered nurses who did the assessments in the nursing homes had been trained and qualified to conduct the assessments. We decided to use in our analyses all first assessments at admission that were done within 180 days from admission to the nursing homes. This time frame, however, could be criticised, as it might have resulted in the health profile of the residents possibly being in better or worse health than in a timeframe closer to the admission date. We did a special analysis to investigate if and how it affected the results to use 180 days instead of 90 days from admission, as reported by others [35]. No significant difference was found between the outcomes of the analysis between the two different time frames, but the chosen time frame allowed us to include 1416 more residents than if we had only included assessments done within 90 days from admission. Over the study period the percentage of MDS assessments conducted within 90 days from admission increased, and in the last 6 years of the analysed period, between 76 and 81% of the MDS assessments were conducted within 90 days from admission.

The main strengths of this study are that it covers all the nursing homes in the whole country for a period of 12 years and admission data covers 5,242 nursing home residents. This means that 72% of all new Icelandic nursing home residents' MDS admission tests over the 12 years were included in the study. Thus, it should be noted that as the data contains information on such a large proportion of the target population this can be considered to limit substantially the risk of random statistical error in the findings.

The results of this study add important knowledge about the health status and functional profile of residents with and without diabetes at admission to nursing homes. Residents with diabetes are younger and have better cognitive performance, but more physical disability and serious comorbidities than others, implicating that residents with diabetes need more complex care in nursing homes, an area where more research is needed in. Nursing homes' staff need to be current in diabetes management to provide quality care. These results also confirm the need for activities and strategy to prevent or delay the development of type 2 diabetes.

Conflict of Interest

The authors declare no conflict of interest.

Authors' contributions

AKS, KO, RHA and IH designed the study. KO worked on the data analysis in cooperation with other authors. AKS coordinated the study and drafting of the manuscript. Critical revisions for important intellectual content: KO, RHA and IH.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical approval

This research project was approved by the Icelandic National Bioethics Committee (VSNb2013030008/03.15), the Data Protection Authority of the Icelandic Ministry of Justice (2013030392HGK) and the Icelandic Directorate of Health (1303070/5.6.1/gkg).

References

1 Abdelhafiz AH, Sinclair AJ. *Low HbA1c and increased mortality risk-is frailty a confounding factor?* Aging Dis 2015;6:262-70.

2 Guariguata L, Whiting DR, Hambleton I, et al. *Global estimates of diabetes prevalence for 2013 and projections for 2035.* Diabetes Res Clin Pract 2014;103:137-49.

3 Luppa M, Luck T, Weyerer S, et al. *Prediction of*

institutionalization in the elderly. A systematic review. Age Ageing 2009;39:31-8.

4 Rodríguez-Sánchez B, Angelini V, Feenstra T, et al. *Diabetes-associated factors as predictors of nursing home admission and costs in the elderly across Europe.* J Am Med Dir Assoc 2017;18:74-82.

5 Travis SS, Buchanan RJ, Wang S, et al. *Analyses of nursing home residents with diabetes at admission.* J Am Med Dir Assoc 2004;5:320-7.

6 Zarowitz B, Allen C, O'Shea T, et al. *Type 2 diabetes mellitus treatment patterns in US nursing home residents*. Postgrad Med 2015;127:429-37.

7 Szczerbińska K, Topinková E, Brzyski P, et al. *The characteristics of diabetic residents in European nursing homes: Results from the SHELTER Study.* J Am Med Dir Assoc 2015;16:334-40.

8 Gaugler JE, Duval S, Anderson KA, et al. *Predicting nursing home admission in the U.S: a meta-analysis.* BMC Geriatr 2007;7:13.

9 Meneilly GS, Knip A, Tessier D. *Clinical practice guidelines. Diabetes in the elderly.* Can J Diabetes 2009;33:180-90.

10 Wong E, Backholer K, Gearon E, et al. *Diabetes and risk of physical disability in adults: a systematic review and meta-analysis.* Lancet Diabetes Endocrinol 2013;1:106-14.

11 Mor V. *A comprehensive clinical assessment tool to inform policy and practice: applications of the minimum data set.* Med Care 2004;42:59.

12 InterRAI. *Scales: status and outcome measures*. 2018 (http://www.interrai.org/scales.html. Accessed 9th May, 2018).

13 Mor V, Angelelli J, Jones R, et al. *Inter-rater reliability of nursing home quality indicators in the U.S.* BMC Health serv Res 2003;3:20.

14 Directorate of Health. *Resident assessment instrument. 2017* (https://www.landlaeknir.is/gaedi-og-eftirlit/heilbrigdisthjonusta/eftirlit-med-stofnunum-og-starfsstofum/raimat/. Accessed 30th October, 2017).

15 Carpenter GI, Hastie CL, Morris JN, et al. *Measuring change in activities of daily living in nursing home residents with moderate to severe cognitive impairment.* BMC Geriatr 2006;6:7.

16 Hirdes JP, Frijters DH, Teare GF. *The MDS-CHESS scale: a new measure to predict mortality in institutionalized older people.* J Am Geriatr Soc 2003;51:96-100.

17 Gruber-Baldini AL, Zimmerman SI, Mortimore E, et al. *The validity of the minimum data set in measuring the cognitive impairment of persons admitted to nursing homes.* J Am Geriatr Soc 2000;48:1601-6.

18 Burrows AB, Morris JN, Simon SE, et al. *Development of a minimum data set-based depression rating scale for use in nursing homes*. Age Ageing 2000:165-72.

19 Fries BE, Simon SE, Morris JN, et al. *Pain in U.S. nursing homes: validating a pain scale for the Minimum Data Set*. Gerontolgist 2001;41:173-9.

20 Zhang X, Decker FH, Luo H, et al. *Trends in the prevalence and comorbidities of diabetes mellitus in nursing home residents in the United States: 1995-2004*. J Am Geriatr Soc 2010;58:724-30.

21 Andreassen LM, Sandberg S, Kristensen GBB, et al. *Nursing home patients with diabetes: prevalence, drug treatment and glycemic control*. Diabetes Res Clin Pract 2014;105:102-9.

22 Haugstvedt A, Graue M, Aarflot M, et al. *Challenges in maintaining satisfactory documentation routines and evidence-based diabetes management in nursing homes*. Int Diabet Nurs 2016 Dec 15:1-6.

23 Andersen K, Aspelund T, Gudmundsson EF, et al. *Five decades of coronary diseases in Iceland: data from the Icelandic Heart Association*. Icelandic Med J 2017;103:411-20.

24 OECD. *Obesity Update 2017*. OECD Health Statistics 2017. Forthcoming in June 2017 (www.oecd.org/health/health-data.htm. Accessed 30th November, 2017).

25 Resnick HE, Heineman J, Stone R, et al. *Diabetes in U.S. nursing homes, 2004.* Diabetes Care 2008;31:287-8.

26 Dybicz SB, Thompson S, Molotsky S, et al. *Prevalence of diabetes and the burden of comorbid conditions among elderly nursing home residents.* Am J Geriatr Pharmacother 2011;9:212-23.

27 Russell LB, Valiyeva E, Roman SH, et al. *Hospitalizations, nursing home admissions, and deaths attributable to diabetes.* Diabetes Care 2005;28:1611-7.

28 Feldman SM, Rosen R, DeStasio J. *Status of diabetes management in the nursing home setting in 2008: a retrospective chart review and epidemiology study of diabetic nursing home residents and nursing home initiatives in diabetes management.* J Am Med Dir Assoc 2009;10:354-60.

29 Rhee SY, Kim YS. *Peripheral arterial disease in patients with type 2 diabetes mellitus*. Diabetes Metab J 2015;39:283-90.

30 Barreto SP, Sanz C, Vellas B, et al. *Drug treatment for diabetes in nursing home residents.* Diabet Med 2014;31:570-6.

31 Sjöblom P, Tengblad A, Löfgren U, et al. *Can diabetes medication be reduced in elderly patients? An observational study of diabetes drug withdrawal in nursing home patients with tight glycaemic control.* Diabetes Res Clin Pract 2008;82:197-02.

32 Dunning T, Sinclair A. *The IDF global guideline for managing older people with type 2 diabetes: implications for nurses*. J Diabet Nurs 2014;18:145-50.

33 Hommel A, Ulander K, Bjorkelund KB, et al. *Influence of optimised treatment of people with hip fracture on time to operation, length of hospital stay, reoperations and mortality within 1 year*. Injury 2008;39:1164-74.

34 Shin JH, Scherer Y. *Advantages and disadvantages of using MDS data in nursing research.* J Gerontol Nurs 2009;35:7-17.

35 Hjaltadóttir I, Hallberg IR, Ekwall, AK, et al. *Health status and functional profile at admission of nursing home residents in Iceland over 11-year period.* Int J Older People Nurs 2012;7:177-87.