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Examining the Risk of Delirium Among Residents with Diabetes in Long-Term Care Homes Across Ontario

Roberta Heale, NP-PHC, MN, DNP, PhD
Full Professor, Laurentian University, Canada
Robyn Gorham, NP-PHC, MN, EdD
Associate Professor, Laurentian University, Canada
Lori Rietze, RN, MSc, PhD
Associate Professor, Laurentian University, Canada
Laura Hill, NP-Adult, MScN
Sessional Professor, Laurentian University, Canada
NP Health Sciences North, Canada

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Abstract

Aim: To examine risk factors for delirium in residents with diabetes in Ontario's LTC homes. **Scope:** Residents in long-term care (LTC) are vulnerable to negative outcomes related to diabetes, including delirium. Understanding factors related to the risk of delirium for residents with diabetes provides the foundation for the mitigation of delirium in this population. **Methods:** A population-based retrospective analysis of the RAI-MDS dataset (2019–2020) was conducted. **Findings:** Diabetes was associated with a statistically significant increased risk of delirium (Odds Ratio: 1.073, CI 1.038–1.109), compounded by polypharmacy. **Conclusions:** Comprehensive delirium mitigation strategies are needed for this vulnerable population. Strategies to mitigate delirium in this population should be implemented.

Keywords: Diabetes, delirium, older person, long-term care, Ontario

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Introduction

The management of patients with diabetes presents a multifaceted challenge, with a spectrum of potential complications that can significantly impact both morbidity and mortality rates. Among these complications, delirium emerges as a particularly perilous entity, often overlooked amidst the intricate web of diabetes-related concerns. In vulnerable populations, such as residents of long-term care facilities, the risk of underreporting delirium is pronounced, because of the nuanced presentation that mirrors the symptoms of other conditions such as behaviours of dementia. This paper endeavors to unravel the intricate interplay between diabetes, delirium, and the challenges associated with identifying and addressing this lethal complication within the context of long-term care settings. By exploring these complexities, we aim to enhance clinical understanding and highlight the importance of comprehensive assessment strategies tailored to the unique needs of diabetic patients, particularly in vulnerable populations susceptible to under recognition of delirium.

Delirium is an acute cognitive disturbance in attention and awareness requiring urgent medical attention (Kotfis et al., 2022). Symptoms of hyperactive delirium can include restlessness or agitation, with increased verbalization or physical movements. Hypoactive delirium can present as lethargy, a decreased level of consciousness or not engaging with outside stimuli, at times looking similar to a depressive state. The two subtypes can also exist together, with the patient fluctuating between hyperactive and hypoactive, giving the mixed state delirium (la Cour et al., 2022). Although delirium is reversible, it must be recognized and treated early as it can otherwise lead to permanent deterioration in activities of daily living, frailty, and death (Gagliardi, 2008; Iglseder et al., 2022; Stollings et al., 2021). Delirium is the most common acute cognitive disorder in geriatric patients, which often goes unrecognized and results in hospitalization (Iglseder, et al., 2022). Given the potential outcomes of delirium, it is important to identify predisposing and precipitating risk factors for delirium in older persons to assist healthcare providers in developing strategies to prevent, diagnose, and treat it early. Prevention and early treatment have the potential to greatly reduce adverse events and prevent early death (Inouye et al., 2014; Registered Nurses Association of Ontario, 2016). However, more than a quarter of all LTC residents have diabetes (Osman, 2015), but care in LTC is typically provided by non-regulated care providers who may not accurately assess patients for delirium so many cases may be missed.

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Residents of long-term care (LTC) are often frail and vulnerable to sudden health changes that result in delirium. A hallmark sign of delirium is an underlying medical disorder, such as a urinary tract infection (Gagliardi, 2008). Research identifies common patient characteristics and diagnoses that predispose LTC residents to delirium including depression and anxiety (Gagliardi, 2008; Kalish et al., 2014; Registered Nurses Association of Ontario, 2016), polypharmacy (Mordarska & Godziejewska-Zawada, 2017), sleep deprivation (Watson et al., 2012), multimorbidity (Ahmed et al., 2014), psychosocial stressors (van Loveren et al., 2021), and glucose dysregulation or diabetes (Kotfis et al., 2019; van Keulen et al., 2018). Further, Fortini et al. (2014) men with delirium who were institutionalized were more likely to have diabetes. The complexity of diabetes and its multifactorial impact on many body systems points to the need for a closer look at this as a risk factor for delirium.

Delirium and Diabetes

A systematic review of 195 studies demonstrated that the positive association between diabetes and delirium derived from studies of older adults in hospital, after surgery, or an accident such as a hip fracture (Ormseth et al., 2023). Another observational study, conducted in Quebec, established the relationship between diabetes and delirium but included only 273 cases (McCusker et al., 2013).

Several mechanisms have been proposed to explain the relationship between delirium and diabetes. Research suggests that hypoglycemic and hyperglycemic events in individuals with diabetes disrupt glucose metabolism, impair brain function, and increase susceptibility to delirium (Lopes & Pereira, 2018; Punthakee et al., 2018). Additionally, delirium in older adults may be triggered by disruptions in neurotransmitters and cellular metabolism in the brain, with abnormal glucose levels associated with diabetes serving as a contributing factor (Inouye et al., 2014; Kalish et al., 2014; Lopes & Pereira, 2018).

It is also known that hypoglycemia, hyperglycemia, insulin usage, and sensory impairments can cause disorientation, confusion, falls, and injuries that lead to the use of analgesics and predispose patients to delirium (Altomare et al., 2018; Berra et al., 2019; Fong et al., 2015; Inouye et al., 2014; Kalish et al., 2014; Moon & Park, 2018; McCusker et al, 2013). Further, Lopes and Pereira (2018) found that hyperglycemia in the absence of a hyperglycemic hyperosmolar event or diabetic ketoacidosis is a factor for hyperactive delirium in those with type 2 diabetes. Although there is literature associating delirium and diabetes in the elderly, it has not been studied in the context of LTC residents (Ormseth, 2023).

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The purpose of this study was to examine risk factors of delirium for residents with diabetes in LTC homes in Ontario. There is potential for these findings to influence policy and practice related to routine care for residents with diabetes in LTC.

Methods

A population-based, retrospective secondary analysis was conducted using the Resident Assessment Instrument-Minimum Data Set (RAI-MDS) 2.0 (2000) assessments from the period of April 1, 2019, to March 31, 2020, for all residents in 623 LTC homes across Ontario, living with or without diabetes. The analysis explored differences between those with and without diabetes, with a focus on the likelihood of delirium and associated factors.

RAI MDS data are collected by the Canadian Institute for Health Information which is authorized under Section 45 of the Ontario Personal Health Information Protection Act (PHIPA) to collect personal health information for analysis or compiling statistical information. CIHI must adhere to rigorous reviews to continue to maintain this authority (CIHI, 2013). This research is a secondary analysis of data received by CIHI that was collected for health improvement research and which was fully de-identified in a rigorous process before its release and required proof of ethics approval, which was received from Laurentian University's Research Ethics Board.

In Canada, LTC homes use the RAI-MDS to collect resident demographic data, and information about residents' strengths, needs, and functional and cognitive status (Centers for Medicare and Medicaid Services, 2005). Trained professionals complete RAI MDS assessments on all residents of LTC homes who have been admitted for at least 14 days, and the assessment is repeated quarterly, annually, and when residents experience a change in health status (Centers for Medicare and Medicaid Services, 2005).

The variables chosen from the RAI MDS that were included in the analysis represent the symptoms of delirium, conditions that may increase the risk of delirium, and whether the condition of delirium was recognized.

They included dementia, delirium, behaviour symptoms of dementia (wandering, verbally abusive behavioural symptoms, physical behavioural symptoms, socially inappropriate/disruptive behavioural symptoms, and resists care), falls, insomnia, mood patterns, and medications.

In previous studies, these variables have been associated as factors of delirium that when seen in combination directly affect the risk, severity, and length of delirium (Fong, et al., 2015; Inouye et al., 2014; Kalish et al., 2014; Moon & Park, 2018; Quinlan et al., 2011).

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Since these variables had all been identified as risk factors for delirium and the purpose of the study was to determine their relationship with LTC residents with diabetes and, therefore, the risk of delirium, none were considered redundant, and they were all included in the regression analysis (ArcMap, 2019). The variable 'psychosis' was excluded from this review because it is typically categorized as a diagnosis, such as schizophrenia, rather than a symptom. This distinction was made to avoid conflating psychosis with symptoms specific to delirium, ensuring a clear focus on delirium-related factors.

Analysis

The dataset consisted of the RAI MDS assessments for each resident, resulting in 101,175 cases for analysis. Using SPSS (25), variables were coded so that they were all either dichotomous or continuous. A descriptive analysis was conducted to determine frequencies for all the variables. See Table A for the frequency of variables and Table B for the frequency of variables with and without diabetes. A chi-square test for association was conducted to determine whether there was a significant association between the presence of diabetes and the key variable delirium.

A model was developed for univariate binomial logistic regression analysis. The Omnibus Tests of Model Coefficients showed that the model was statistically significant. Hosmer and Lemeshow's analysis demonstrated a good model fit. The Nagelkerke R^2 explained that the variation in the dependent variable based on our model was 10.6%. The percentage accuracy in the classification of the model was 72.2%. Binomial logistic regression analysis was used to determine the associations between those with diabetes and the variables that were risk factors for delirium.

Table A: Frequencies of Variables

Variable	**Range**	**Mean**		**missing**
age	< 20 - 113	86.63 years		0
Variable	**Categories**	**Frequency out of 101,175 cases**	**%**	**missing**
sex	Male female	33,029 68,185	32.6 67.3	140
Diabetes	No yes	73027 28148	72.18 27.82	0
Delirium	No signs of delirium Signs of delirium	57503 43672	56.84 43.16	0
Dementia	No yes	57109 44066	56.45 43.55	0
Insomnia	not exhibited in 30 days	84678 16497	83.69 16.31	0

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	exhibited in past 30 days			
Fall in the Past 30 Days	No yes	82222 18953	81.27 18.73	0
Depressed, Sad or Anxious Mood	No yes	46035 55140	45.50 54.50	0
Change in Mood Status	No yes	85204 15971	84.22 15.78	0
Sad Facial Expression	No yes	62420 38755	61.70 38.30	0
Crying Observed	No yes	89643 11532	88.61 11.39	0
Disruptive Behaviour	No yes	81597 19578	80.64 19.36	0
Resists Care	No yes	65787 35388	65.02 34.98	0
Wandering	No yes	86303 14872	85.30 14.70	0
Wandering Not Easily Altered	No yes	94973 6202	93.87 6.13	0
Verbally Abusive Behaviour	No yes	84408 16767	83.43 16.57	0
Verbally Abusive Behaviour Not Easily Altered	No yes	94330 6845	93.23 6.77	0
Physically Abusive Behaviour	No yes	89437 11738	88.40 11.60	0
Physically Abusive Behaviour Not Easily Altered	No yes	96350 4825	95.23 4.77	0
Use of Analgesics	None yes in past week	32930 68245	32.55 67.45	0
Use of Antipsychotics	None yes in past week	75360 25815	74.48 25.52	0
Use of Antianxiety Medication	None yes in past week	91515 9660	90.44 9.66	0
Use of Hypnotics	None yes in past week	97593 3582	96.46 3.54	0
Use of Antidepressants	none yes in past week	43342 57833	42.83 57.17	0
Use of Diuretics	none yes in past week	75497 25678	74.62 25.38	0

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Table B: Frequency of Variables With and Without Diabetes

Variable	With diabetes	No diabetes	missing
Delirium	43,801 (43.3%)	57,312 (56.7%)	0
Dementia	24,044 (23.7%)	77,131 (76.3%)	0
Insomnia	16,848 (16.7%)	84, 265 (83.3%)	0
Fall in the past 30 days	18,632 (18.4%)	82,683 (81.6%)	0
Depressed, sad or anxious mood	38,617 (38.2%)	62,496 (61.8%)	0
Change in mood status	16,434 (16.3%)	84,679 (83.7%)	0
Sad facial expression	19, 484 (19.3%)	79,691(78.8%)	0
Crying observed	11479 (11.4%)	89,634 (88.6%)	0
Disruptive behaviour	19,345 (19.1%)	81,768 (80,9%)	0
Resists care	35428 (35%)	65,685 (65%)	0
Wandering	13,959 (13.8%)	87,154 (86.2%)	0
Wandering not easily altered	5,890 (5.8%)	95,223 (94.2%)	0
Verbally abusive behaviour	16,664 (16.5%)	84,449 (83.5%)	0
Verbally abusive behaviour not easily altered	6,685 (6.6%)	94,428 (93.4%)	0
Physically abusive behaviour	10,845 (10.7%)	89,480 (88.5%)	0
Physically abusive behaviour not easily altered	4,770 (4.7%)	96,343 (95.3%)	0
Analgesics	69,775 (68.9%)	31,540 (31.1%)	0
Antipsychotics	26,032 (25.7%)	75, 283 (74.3%)	0
Anti-anxiety medication	9,871 (9.7%)	91,444 (90.3%)	0
Hypnotics	58,369 (57.6%)	42,946 (42%)	0
Antidepressants	3,610 (3.6%)	97,705 (96.4%)	0
Diuretics	25,885 (25.5%)	75,430 (74.5%)	0

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Results

The number of residents in the study with diabetes was 27.8% (n=28,178), which is comparable to Canada's national rate (Meneilly, 2018). The chi-square test for association demonstrated a statistically significant association between diabetes and delirium, $\chi^{2(1)} = 145.488$, $p = >0.001$.

For the binomial logistic regression, having diabetes was associated with an increased likelihood of developing delirium in LTC in this population (p = 0.001; Odds 1.073; CI 1.038-1.109). Although the association is significant, this is not a strong association. However, the results should not be dismissed given the potential for missed cases of delirium and subsequent adverse outcomes. Rather, it warrants further investigation.

Diabetic residents were more likely to have polypharmacy of analgesics, antipsychotics, anti-anxiety, hypnotics, and antidepressants (Table C), thereby predisposing these residents to delirium. Residents having diabetes were 1.5 times more likely to have taken analgesics and anti-anxiety medications within seven days before the assessment than residents who did not have diabetes.

Table C: Determination of Variables Associated with Diabetes in LTC Residents
Reference category diabetes: 1 = resident has diabetes

	B	S.E.	Wald	df	p	Odds ratio	95% C.I for Exp(B)	
							Lower	Upper
Dementia	.017	.016	1.199	1	.274	1.101	.987	1.049
Delirium	.070	0.17	17.337	1	.000	1.073	1.038	1.109
Insomnia	-.055	.022	6.496	1	.011	.946	.907	.987
Fall in the Past 30 Days	-.024	.019	1.616	1	.204	.976	.940	1.013
Depressed, Sad or Anxious Mood	.094	.019	23.932	1	.000	1.099	1.058	1.141
Change in Mood Status	.009	.021	.183	1	.669	1.009	.968	1.051
Sad Facial Expression	.007	.019	.123	1	.726	1.007	.970	1.045
Crying Observed	.109	.026	18.076	1	.000	1.115	1.061	1.173
Disruptive Behaviour	- .082	.023	12.733	1	.000	.922	.881	.964

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Resists Care	.012	.019	.371	1	.542	1.012	.975	1.050
Wandering	.149	.024	26.470	1	.000	1.160	1.096	1.228
Wandering Not Easily Altered	.066	.042	2.457	1	.117	1.069	.984	1.161
Verbally Abusive Behaviour	-.104	.029	12.714	1	.000	.901	.851	.954
Verbally Abusive Behaviour Not Easily Altered	-.057	.042	1.917	1	.166	.944	.870	1.024
Physically Abusive Behaviour	.027	.034	.607	1	.436	1.027	.960	1.099
Physically Abusive Behaviour Not Easily Altered	-.014	.051	.081	1	.776	.986	.893	1.089
Use of One or More Medications	.145	.002	5682.645	1	.000	1.156	1.151	1.160
Use of Analgesics	.421	.017	635.194	1	.000	1.524	1.475	1.575
Use of Antipsychotics	.046	.018	6.664	1	.000	1.047	1.011	1.084
Use of Antianxiety Medication	.441	.026	278.708	1	.000	1.554	1.476	1.637
Use of Hypnotics	.292	.040	53.250	1	.000	1.339	1.238	1.448
Use of Antidepressants	.201	.016	161.893	1	.000	1.223	1.186	1.262
Use of Diuretics	-.016	.017	.817	1	.366	.985	.952	1.018

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Discussion

The findings of this study underscore the critical intersection between diabetes and the risk of delirium in older adults, particularly those residing in LTC facilities. Results also confirm that residents with diabetes were more likely to use analgesics, antipsychotics, hypnotics, antianxiety, and antidepressant medications which further compound their risk for delirium (Friedrich et al., 2022; Leon-Salas et al., 2020). The risk of delirium for residents with diabetes indicates the necessity for judicious use of medications for this group, especially those that impact cognitive function (Gagliardi, 2008).

In our study dementia was not significantly associated with diabetes. However, diabetes was associated with an increased likelihood of some of the behavioural presentations of dementia and delirium namely depressed mood/anxiety, crying, wandering, and mood persistence (Abengana et al., 2017; Gagliardi, 2008). In the absence of a diagnosis of dementia, these symptoms warrant investigation as possible unrecognized hyperactive delirium (Abengana et. al., 2017).

Residents with diabetes were significantly less likely to experience insomnia. However, research indicates that poor sleep patterns and inappropriate behaviors are so prevalent among older adults living in LTC homes that they may not appear to be strongly linked to a single factor, such as diabetes (Kim & Yoon, 2020; McCarthy, 2021; Song et al., 2019).

The findings of this study provide useful information for the gold standard diabetes clinical practice guidelines from various countries (American Diabetes Association, 2023; NICE, 2022; Meneilly et al., 2018).

In these guidelines, diabetes care for older adults continues to be predominantly a medical-based approach, focusing on glycemic levels and medications.

Even though the guidelines discuss issues such as polypharmacy, dementia, frailty, and the recommendation for looser glycemic control, none of the practice guidelines describe the importance of assessing for the signs, symptoms, or risk factors of delirium.

Clinicians should also be guided to assess for the cautionary use of medications that are likely to cause delirium.

In summary, guidelines should be revised to include strategies for the assessment of the risk of delirium for those with diabetes in LTC facilities especially for a resident displaying new behavioural signs of “dementia”. Recognition of the risk for delirium with diabetes sets the stage for the mitigation of delirium in this population.

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Strengths, Limitations, and Gaps

A strength of this study is the use of the RAI-MDS dataset, which is mandated for use in all LTC homes in Ontario. This minimizes selection bias, as the dataset captures information from a comprehensive population of residents in LTC. The risk of bias was also mitigated through the use of the validated RAI-MDS indicators for delirium and diabetes to ensure consistent classification. In addition, multivariate analyses were conducted to adjust for known confounders, such as age, sex, comorbidities, and polypharmacy, which could otherwise introduce bias into the observed associations. However, since the data are inputted by care providers in LTC, there was also a possibility of reporting bias or data omission.

All the significant variables had low odds ratios. This creates difficulty in applying the results in a clinical setting. However, they provide a foundation for future research. For example, additional variables would have been beneficial to provide a more comprehensive review of the risk of delirium for LTC residents with diabetes. For example, variables that are representative of both the hyperactive and hypoactive types of delirium would have been helpful. Variables such as type of diabetes, range of glycated hemoglobin (A1C) levels, treatment regimen (including new medications), or stage of frailty with diabetes would have enhanced the results. Further defining the risk factors and understanding which specific risks exist may lead to focused strategies and policy development focusing on clinical practice, for prevention in this population (Kalish et al., 2014). For example, with considerable new treatments for diabetes such as Mounjaro, it would be interesting to know if any of these have an impact on delirium in our population so that policy can be developed to guide clinical practice (Chavda et al., 2022).

It should be noted that a state of emergency was declared with respect to the COVID-19 pandemic on March 23, 2020, and that mask guidance was announced on March 26, 2020. However, the dataset did not identify LTC facilities with COVID-19 outbreaks (CIHI, 2022). Therefore, the impact of possible COVID cases on residents on the analysis of the dataset is not known.

Conclusion

This study explored risk factors of delirium for those with diabetes in LTC. We confirmed that those with diabetes have higher risks for delirium. In addition, some behavioural symptoms of dementia were more likely to be seen in residents with diabetes, identifying the need for careful delirium screening. Results also showed that LTC residents with diabetes were more likely to take multiple medications including analgesics and psychotropics. Implications of this study call for judicious use of medications to be warranted with all residents of LTC, but specifically those with diabetes to reduce their risk of delirium.

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The information gained from this study can be utilized to guide future research to develop strategies and interventions for the early detection and treatment of delirium in all residents of LTC, especially those who have diabetes.

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Data Availability: All data are included in the content of the paper.

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Declaration for Human Participants: This study was approved by the Research Ethics Board at Laurentian University for research involving human subjects, file number 6020663, which adheres to the principles of the Helsinki Declaration.

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