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Original research

Family Physician Clinical Inertia in Managing Hypoglycemia

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ABSTRACT

Aims: Clinical inertia behaviour affects family physicians managing chronic disease such as diabetes. Literature addressing clinical inertia in the management of hypoglycemia is scarce. The objectives of this study were to create a measurement for physician clinical inertia in managing hypoglycemia (ClinInert_InHypoDM), and to determine physicians' characteristics associated with clinical inertia.
Methods: The study was a secondary analysis of data provided by family physicians from the InHypo-DM Study, applying exploratory factor analysis. Principal axis factoring with an Oblimin rotation was employed to detect underlying factors associated with physician behaviors. Multiple linear regression was used to determine association between the ClinInert_InHypoDM scores and physician characteristics.
Results: Factor analysis identified a statistically sound 12-item one-factor scale for clinical inertia behavior. No statistically significant differences in clinical inertia score for the studied independent variables were found.
Conclusions: This study provides a scale for assessing clinical inertia in the management of hypoglycemia. Further testing this scale in other family physician populations will provide deeper understanding about the characteristics and factors that influence clinical inertia. The knowledge derived from better understanding clinical inertia in primary care has potential to improve outcomes for patients with diabetes.

1. Introduction

Management of the patient with diabetes mellitus (DM) embodies the spirit of primary care medicine. Because of the chronic, progressive, and potentially disabling nature of this illness, family physicians (FP) are often at the cornerstone of diabetes care [1]. This gate-keeping position allows professionals to screen high-risk patients for diabetes, initiate treatment, manage hyperglycemia, monitor, and fine-tune pharmacologic therapies, as well as detect and manage microvascular and macrovascular complications.

Evidence suggests that tight glycemic control reduces morbidity and mortality of DM. However, the resulting risk of hypoglycemia can present a barrier to optimizing therapy and challenge patient medication adherence [2,3].

Iatrogenic hypoglycemia is a well-known adverse event of insulin use in people with type 1 diabetes (T1DM) but is also seen in type 2 diabetes (T2DM) patients managed by insulin and/or secretagogues [4]. Ratzki-Leewing et al. [5] analyzed the results of one of the largest real-world investigations of hypoglycemia epidemiology in Canada, the InHypo-DM Study [6]. Findings from this study revealed that the incidence of iatrogenic hypoglycemia among adults with T2DM taking insulin and/or secretagogues is higher than commonly believed. While 83.0% of people with T1DM reported having experienced at least one hypoglycemic event with an overall annualized hypoglycemia rate of 58.1 events per person-year, 62.0% of T2DM individuals experienced at least one hypoglycemia event at a rate of 30.4 events per person-year. The Canadian study also challenged prevailing misconceptions that severe hypoglycemia in T2DM is relatively infrequent [4]. Ratzki-Leewing et al. found that among patients with DM reporting any type of hypoglycemic event, the incidence rate of severe hypoglycemia was approximately 37% higher in people with T2DM than that found among those respondents with T1DM [5].

Research has identified a disconnect between the clinical goals outlined in evidence-based guidelines for DM management and real-life clinical practice which can be referred to as clinical inertia [7–9]. One study identified characteristics of physicians who were most likely to

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follow DM guidelines related to hyperglycemia, and therefore less inclined to clinical inertia. These include being female, recently completed medical training, frequently use of a computerized medical record and working in group practice [10]. Additionally, competing demands on the physician in the patient-physician encounter has been associated with clinical inertia concerning hyperglycemia [11]. Another study found that 75.5% of physicians would be more aggressive treating hyperglycemia in their patients with diabetes if not for concerns about hypoglycemia [12]. Clinical inertia [13] has been recognized as an important barrier to the management of many chronic diseases, including DM [6,14].

Despite its clinical importance, there is a paucity of literature addressing behaviors that comprise family physician clinical inertia concerning hypoglycemia. This study sought to redress this lack by examining factors that make up FP clinical inertia in hypoglycemic management. The primary objective of this study was to develop a measure of clinical inertia specific to hypoglycemia that could be useful as part of an education intervention, particularly for continuing medical education. A secondary objective was to determine if there was a correlation between clinical inertia and FP characteristics.

2. Methods

2.1. Study design, population, and data collection

The present investigation was a secondary cross-sectional analysis of the "UnderstandINg the impact of HYPOglycemia on Diabetes Management: A Survey of Perspectives and Practices" (InHypo-DM Study) [5]. Exploratory factor analysis (EFA), employing Principal Axis Factor (PAF) extraction with Oblimin rotation, was used to investigate the factor structure of questionnaire items related to clinical inertia. Conceptually, the underpinnings that guided the responses to these items might identify a behavior pattern for clinical inertia. EFA was used because this was an exploratory analysis with no prior theory available to explain the phenomenon of clinical inertia [15–17]. The sample for this study consisted of the sub-set of FPs who completed the InHypo-DM healthcare provider (HCP) questionnaire (Appendix 1). In 2016, HCPs were recruited from two online survey panels: the professional sections of the Canadian Diabetes Association, which consisted of 3,584 members, and an HCP panel of 5,579 members maintained by Professional Targeted Marketing (PTM), a Canadian healthcare communications company. Individuals were recruited via an invitation email that contained a Qualtrics link to the InHypo-DMHCPQ. Fig. 1 describes the sampling method for the InHypo-DM Study. Of the invited 9,163 HCPs, 889 responded, of whom 162 were FPs.

Participants were asked to complete the 63-item InHypo-DMHCPQ in either English or French. Data were collected on HCP's attitudes and clinical behaviours related to hypoglycemia management (5-point Likert scale) as well as socio-demographics. The questionnaire was informed by a literature review, theory-driven qualitative interviews with HCP, and expert consultation. Questions pertaining to clinical inertia were extracted from this dataset.

2.2. Variables

Regarding the primary objective, to develop a clinical inertia scale, we used the 13 items from the questionnaire that explored physician attitude and behavior in managing hypoglycemia in their clinical practice. Responses were chosen from five categories, "Never"; "Rarely"; "Sometimes"; "Often"; and "Always". The items of the survey and their variable names are listed in Table 1.

Regarding the secondary objective, to assess the relationship between clinical inertia and physician characteristics, the dependent variable was the scores from the clinical inertia score developed in the primary objective. The independent variables used in this analysis were: age in years; sex; years in practice; practice location; Canadian province where the practice was located; practice type; diabetes educator designation; mean number of diabetes patients seen in an average week; and personal diagnosis of diabetes.

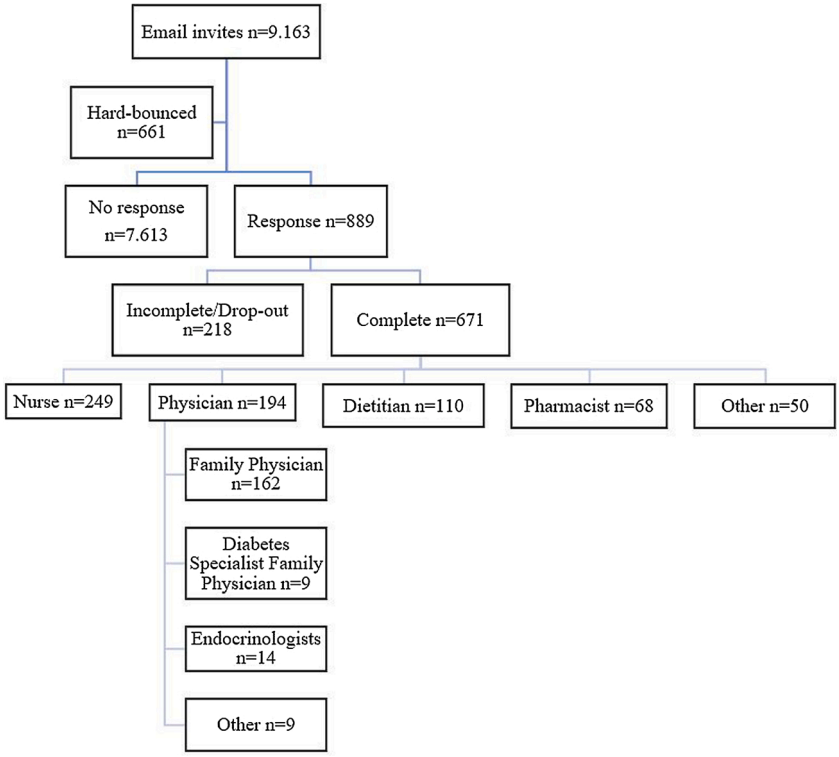

Fig. 1. Sampling diagram.

Table 1
InHypo-DM health care provider survey: hypoglycemia management items.

Name	Item
Effort to track progress	In general, I make an effort to keep track of my patients' progress with regard to managing their hypoglycemia.
Advise to intensify monitoring	In general, I advise my patients to increase the frequency of blood glucose monitoring when they are at increased risk for hypoglycemia.
Preparedness	In general, I make sure that I am prepared to help my patients manage their hypoglycemia.
Time Management	In general, I am confident that I can help my patients manage their hypoglycemia even when there is little time.
Prioritizing specific issues	In general, addressing the specific appointment issue takes priority over discussing their hypoglycemia management.
Routinely help manage	In general, helping my patients manage their hypoglycemia is something I do routinely.
Use of guidelines	In general, helping my patients manage their hypoglycemia is informed by current evidence and guidelines.
Initiative to help improve	In general, I take the initiative to help my patients improve their hypoglycemia management.
Explain how to manage hypo	In general, I explain how to manage hypoglycemia to my patients.
Discuss driving/heavy machinery	In general, I discuss hypoglycemia-related guidelines regarding driving or operating heavy machinery with my patients.
Solicit input	In general, I solicit patients' input when discussing their hypoglycemia management.
Motivational strategies	In general, I use motivational strategies to help my patients manage their hypoglycemia.
Liability concerns	In general, my professional liability, according to my specific regulatory body, directs the way I manage patients' hypoglycemia.

2.3. Analysis

All analyses were conducted using SPSS statistics version 25 [18]. A descriptive analysis examined the distribution of all variables. The frequencies and percentages for the responses for each of the 13 potential clinical inertia scale items were run, and missing values were identified. For the independent variables, frequencies and percentages were run for categorical variables and means and standard deviations were calculated for continuous variables.

Exploratory Factor Analysis was used in an iterative process to identify correlations among the 13 potential clinical inertia items that could contribute to a clinical inertia scale. The EFA was conducted only on cases with complete data. The first step in the EFA was to explore assumptions of sample size, factorability of matrix and pattern of distribution to determine suitability of the data set for EFA.

The suitability of the data for factor analysis was assessed by inspection of the correlation matrix for the presence of coefficients of 0.3 and above, indicating factorability of the items. A KMO index value of 0.6 or higher and statistical significance on the Bartlett`s test of Sphericity further supported the adequacy of sample size and factorability of the correlation matrix.

The decision on how many of the extracted factors to keep was guided by the scree plot and the Kaiser's criterion concerning eigenvalues and the total variance explained. The pattern and structure matrices reported factor loadings for each of the 13 potential clinical inertia items on each factor. Factor loading values in the pattern and structure matrices equal or greater than 0.40 were considered relevant.

The achieved pattern matrix was then examined to ensure that items loaded with significant values on each factor and to verify if each factor was composed of items that were conceptually similar in trait. If the produced pattern matrix did not satisfy these criteria, a new round of EFA was run with some choices modified. This process was iterated until a clear and clinically relevant factor solution was found.

Cronbach's Alpha was calculated to assess the reliability of each of the factors and the scale overall. Once a final factor structure for clinical inertia was determined, the clinical inertia score was determined by calculating the mean value of the items in the final factor structure [16].

For the secondary objective, bivariate analyses were conducted to determine the relationship between the clinical inertia score and the independent variables. For continuous variables, Pearson's correlation was used; for dichotomous variables, t-test were used; and for categorical variables with more than two response categories, ANOVA was used. Next, multiple linear regression was performed to explore the relationship between the clinical inertia factor score and the independent variables in the model. Assumptions of normality, linearity, multicollinearity, and homoscedasticity underpinning multiple linear regression, were tested.

3. Results

There were 162 FPs who completed the questionnaire. Table 2 describes the FP participants' characteristics for the categorical variables. The mean age of the sample was 57.5 years (SD 9.65) and respondents had been practicing medicine for a mean of 26 years (SD 11). The number of DM patients seen by these family physicians was, on average, 27 DM patients per week (SD 24).

Frequency for each response category on the items of the questionnaire that addressed physician behavior and attitudes is presented in Appendix 2.

One hundred and sixty respondents completed the section of the questionnaire on behavior characteristic, with only two respondents with missing data. The factor analysis was performed on the respondents without missing data (N 160).

Four iterative rounds of EFA, using PAF extraction, were conducted to find a solution. In the first round, one item loaded on its own factor and therefore was deleted. In the second round, we ran the remaining 12 items and found a two-factor solution; however, there was no clear clinical distinction between the two factors. In the third round, we once again ran an EFA of the 13 items, constraining the items to a one-factor solution. We then ran the final round which produced a 12-item scale, and we excluded the item called "Priorities" because it had a low loading. All remaining items loaded on the factor with values superior to 0.40. The loadings ranged from 0.437 to 0.682. This 12-item solution explained 54% of the total variance. Table 3 shows the factor loadings for the final round of EFA.

Given both the clinical relevance of this version and the high loadings resulting, the items from this 12-item one-factor solution were chosen to create the clinical inertia scale called the *ClinInert_InHypoDM*.

Table 2
Family physician characteristics (n = 162).

Variable	Response categories	Number (%)
Sex	Male	91 (56.2)
	Female	71 (43.8)
Location	Urban	122 (75.3)
	Rural	40 (24.7)
Province	Western/Prairies	17 (10.7)
	Alberta	12 (7.5)
	Ontario	87 (54.7)
	Quebec	13 (8.2)
	Maritimes	12 (7.5)
	Newfoundland & Labrador	18 (11.3)
Practice Type	Hospital-based	8 (5.4)
	Team-based	63 (42.3)
	Not team-based	69 (46.3)
	Missing	9 (6.0)
Certified diabetes educator	Yes	9 (5.6)
	No	153 (94.4)
Personal diagnosis of diabetes	Yes	14 (8.6)
	No	148 (91.4)

Note: Western/Prairies-British Columbia, Manitoba, and Saskatchewan; Maritime Provinces-Prince Edward Island, New Brunswick, and Nova Scotia.

Table 3
EFA iteration 4 (Final): factor matrix.

Item	Factor loading
Effort to track progress	0.682
Advise to increase monitoring	0.565
Preparedness	0.791
Time Management	0.754
Routinely help manage	0.778
Use of guidelines	0.716
Initiative to help improve	0.840
Explain how to manage hypo	0.791
Discuss driving/heavy machinery	0.642
Solicit input	0.724
Motivational strategies	0.684
Liability concerns	0.437

While sub-scales were identified statistically, there was no conceptual clinical distinction among them.

A *ClinInert_InHypoDM* score was created by calculating the mean of the response for each of the 12 items for each respondent. The mean score for the clinical inertia score was 3.82 out of 5 with a standard deviation of 0.611; the median was 3.83 (IQR 0.67). No reference or cut-off score values were identified for the scale. Rather, higher scores are intended to reflect less clinical inertia because higher scores reflect more positive and proactive behaviors described in the items.

Having established a *ClinInert_InHypoDM* score, the secondary objective was met by conducting a bivariate and a multiple linear regression analysis. There were no significant relationships found in the bivariate analysis. In the first model, age was highly collinear with variable years in practice, with a bivariate correlation of 0.826 (p-value < 0.001). Therefore, age was excluded from the regression and a second multiple linear regression analysis was performed where there was no evidence of multicollinearity. All other assumptions of multiple linear regression were met. There were no statistically significant relationships between the clinical inertia score and the independent variables. Table 4 reports these results.

Table 4
Multiple linear regression.

Model	Unstandardized coefficients	Standard error	95% confidence interval	Sig.
Constant	4.324	0.670	3.00, 5.648	0
Years in practice	0.002	0.005	−0.008, 0.012	0.629
#DM patient/week	0.001	0.002	−0.004, 0.005	0.749
Sex (Reference Male)	−0.179	0.115	−0.406, 0.048	0.121
Location (Reference Urban)	−0.014	0.127	−0.265, 0.236	0.911
CDE (Reference No)	−0.009	0.240	−0.482, 0.465	0.971
Personal DM (Reference No)	−0.180	0.184	−0.543, 0.184	0.33
Province (Reference Ontario)				
Western/Prairies	0.217	0.175	−0.129, 0.563	0.217
Alberta	0.151	0.196	−0.237, 0.538	0.443
Quebec	0.040	0.196	−0.347, 0.426	0.84
Maritimes	−0.206	0.201	−0.605, 0.192	0.307
Newfoundland & Labrador	0.148	0.178	−0.203, 0.499	0.406
Practice Type (Reference Hospital)				
Team-based	0.013	0.146	−0.276, 0.301	0.929
Not team-based	0.021	0.140	−0.256, 0.298	0.881

CDE-Diabetes Educator Designation; DM-Diabetes Mellitus; Western/Prairies-British Columbia, Manitoba, and Saskatchewan); Maritime Provinces-Prince Edward Island, New Brunswick, and Nova Scotia.

4. Discussion

The major contribution of this study is the creation, for the first time, of a clinical inertia scale specific to hypoglycemia management, the *ClinInert_InHypoDM* scale. This practical measure will aid in understanding and measuring this phenomenon, leading to future interventions that can reduce its occurrence in primary care. Clinical inertia in the management of diabetes in primary care is a well-established, common, and ongoing challenge. This issue not only applies to delayed intensification of therapy to optimize glycemic control, but also for overall hypoglycemia management in patients with diabetes [6,14].

As a result of multiple iterations, factor analysis resulted in a 12-point questionnaire with higher scores (ranging from 1 to 5) reflecting less clinical inertia for hypoglycemia.

The multiple regression analysis showed that, for this population, there was no statistically significant association between the *ClinInert_InHypoDM* scale score and FPs' characteristics, including sex, years in practice, average number of DM patients seen per week, practice type, practice location, certified diabetes educator and personal diagnosis of diabetes.

Therefore, based on adjusted analyses, clinical inertia did not seem to be related to characteristics that are not amenable to change, such as gender or years in practice. Nor was it influenced by the location and type of clinical practice. Counterintuitively, clinical inertia had no relation to the physician's experience with DM management measured in the average number of DM patients seen in a regular work week or by being a certified diabetes educator. These results imply that all FPs managing DM patients at risk for hypoglycemia should be watchful for attitudes associated with clinical inertia.

The major strength of this study relevant to primary care is that the *ClinInert_InHypoDM* scale was developed using data from a national sample of FPs in Canada providing diabetes care.

Limitations of this study were mostly related to its method as a secondary analysis. The survey used in this study was based on physicians' self-report of their behaviour and may not reflect actual behavior. However, the questionnaires were anonymous and therefore likely to elicit honest responses. Some key aspects that could measure clinical inertia were not present in the original questionnaire, such as attitudes and behavior of the physician in relation to patient's results on glycemic target or glycosylated hemoglobin levels, or questions about team-based practice, the use of electronic medical records, telehealth and other technology-driven clinical intelligence tools that could aid physicians in protocols and practice guidelines.

A limitation of this study was that the questionnaire did not collect data for the patients of the FP respondents; therefore, we were not able to correlate FP clinical inertia scores to the hypoglycemia profile for their patients with DM. The application of this scale will require further study to determine reference values concerning what constitutes clinical inertia. Future research can assess the relationship between FP scores and clinically relevant outcomes including frequency of severe hypoglycemia, hypoglycemia unawareness, and HbA1c concentration for the DM patients managed by them.

While this research was designed to understand the role of physician behaviors in clinical inertia, future studies should also investigate physician clinical inertia behavior in comparison to their patients' characteristics, such as non-adherence status, glycosylated hemoglobin levels, and presence of comorbidity. The knowledge that will derive from such a comprehensive understanding of the multi-factorial and complex topic of clinical inertia in primary care will undoubtedly

improve outcomes for DM patients.

5. Conclusion

This study was the first of its kind to measure clinical inertia for hypoglycemia management in primary care. As such, it serves as a foundation for future research to test, validate and build upon. The creation of the *ClinInert_InHypoDM* scale for hypoglycemia management is the first step in the development and validation of a scale to measure an important and largely under-studied clinical issue. By using this scale, we may gain an understanding about the factors that influence clinical inertia behavior in FPs in the management of hypoglycemia. It will be useful to further validate the scale in the future in other family physician populations.

Declarations of interest

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Data availability statement

No data are available.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.pcd.2022.02.005.

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