Factors Affecting Fatigue in Patients with Type II Diabetes Mellitus in Korea

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S U M M A R Y
Purpose: This study aimed to characterize and identify the factors affecting fatigue in patients with type II diabetes mellitus in Korea.

Methods: A total of 180 patients with type II diabetes mellitus were recruited from the outpatient clinic of a tertiary care hospital. For data collection, a questionnaire survey of diabetes history, hypoglycemia symptoms, and fatigue was conducted between January and February 2011. Data were analyzed using t test, analysis of variance, Pearson's correlation, and hierarchical multiple regression.

Results: The mean fatigue and hypoglycemia symptom scores of patients with type II diabetes mellitus were 2.88 ± 0.61 and 6.18 ± 12.60, respectively. Hypoglycemia symptoms (p = .004), disease duration (p < .001), and age (p < .001) correlated positively with fatigue. Hierarchical multiple regression analysis revealed that hypoglycemia symptoms was the variable positively influencing fatigue in patients with type II diabetes mellitus after adjustment for influences of demographic and clinical characteristic variables.

Conclusions: Hypoglycemia symptoms were confirmed to be a predictor of fatigue. Consequently, it is essential to consider age, and disease duration as well as hypoglycemia symptoms to intervene fatigue effectively among patients with type II diabetes mellitus.

Introduction

Diabetes has become a global pandemic. According to statistical data, it is forecasted that the number of patients with diabetes will increase from 177 million in 2000 to over 360 million by 2030 [1]. This kind of trend has been detected in Korea as well. According to the Korean National Health and Nutrition Examination Survey (KNHNES), the prevalence of diabetes in adults aged 30 or older has increased from 8.6% in 2001 to 10.1% in 2010 [2].

Patients with diabetes suffer from serious health problems that relate to physical, mental, and social aspects of their lives [3–4]. Fatigue, a common symptom among diabetic patients, may be the direct result of physiological processes, treatment, and complications associated with long-term diabetes [3].

According to previous studies, up to 60% of patients with diabetes experience fatigue symptoms [3,5]. Fatigue has a negative impact on the activities of daily living. In addition, fatigue impairs a patient's concentration and leads to frequent mood fluctuations, which further aggravates their health, increasing the risk of complications and decreasing the quality of life [3–4,6].

Despite the importance of fatigue, many diabetes therapists often ignore its management and underlying factors [3,7]. There are several factors associated with fatigue in diabetes patients, including physiological factors (e.g., hypoglycemia or hyperglycemia) [3,8], psychological factors (e.g., depression and distress related to the disease) [3,8], epidemiological factors (e.g., age and educational background) [9], and health-related factors (e.g., expected disease duration and history of comorbidity) [3–4,7,10].

Hypoglycemia, which is often observed during diabetes treatment, has been suggested by several authors as a particular cause of fatigue [3,8,11]. The relationship between fatigue and hypoglycemia symptoms in patients with type II diabetes is still unknown. Blood
glucose is the primary source of energy in the muscles and the brain, and as the frequency of hypoglycemia symptoms increases, the cells tend to receive inadequate energy supply [10,11]. However, previous studies have not established a clear link between fatigue and hypoglycemia among type II diabetics.

Therefore, the present study aimed to characterize and identify the explanatory power of hypoglycemia symptoms on fatigue in patients with type II diabetes in Korea.

Methods

Study design

This is a cross-sectional retrospective correlative study conducted by a questionnaire survey on factors affecting fatigue in patients with type II diabetes mellitus in Korea.

Samples and procedure

This study conveniently sampled the patients who met the selection criteria attending the outpatient department of a national university hospital from January 10 to February 11, 2011 for the treatment of their diabetes. The selection criteria were as follows: patients with type II diabetes mellitus aged 19 years or older; patients who had been receiving diabetes treatment for more than 6 months; and those who were aware of the purpose of the research and agreed to participate. We excluded patients suffering from any of the following conditions: malignant tumor, acute disease (e.g., infection requiring hospitalization or surgery within 3 months), hypothyroidism, hyperthyroidism, anemia, dementia, mental disease (e.g., schizophrenia or depressive disorder), stroke, kidney disease, diabetic neuropathies, proliferative retinopathy, myocardial infarction in the past 3 months, and heart failure.

A total of 218 people participated in the study; however, 180 were finally chosen and others were excluded due to inadequate responses. To verify the statistical power of our sample size, we used the G*power 3.1.7 program [12]. The sample size required in multiple regression method was 103 with the following parameters: the number of independent variables was 7; power was 80%; Cronbach's alpha was .05; effect size was 0.15 based on previous research [8]. The number of participants providing valid data exceeded 103. Therefore, our sample size seemed appropriate.

To conduct this study, the objectives, methodology, participant rights, and questionnaire survey were reviewed and approved (GNUHIRB-2010-081) by the institutional review board. To maintain consistency in the research method among researchers, a research director gave them instructions on the survey before data collection. The interviews were conducted after the researchers were taught how to collect accurate data. Patients who met the criteria for this study were first confirmed by a researcher and an inspector from the digital medical records department of the Division of Endocrinology in a national university hospital. The objectives and process of the study were explained to the target patients verbally and in writing. If they agreed to participate in the study, they were asked to give written informed consent. It took about 10–15 min for each respondent to fill out the questionnaire forms. Data were collected anonymously to protect participant rights and privacy. It was agreed that data would not be used for other purposes. They were also informed that they could give up on the survey at any time.

Hypoglycemia symptom assessment

Previous studies have revealed a high frequency of hypoglycemia symptoms [13,14]. In this study, hypoglycemia symptoms refers to the frequency of tremor, palpitation, hunger, or sweating in our patients with type II diabetes mellitus anytime during the last month. A hypoglycemia symptom assessment tool was developed based on hypoglycemia subscales of the Diabetes Symptom Checklist-Revised [15]. A preliminary version of this tool was initially assessed by one endocrinologist and three professors in adult health nursing. The final measurement tool included the following questions: “Have you experienced tremor, palpitation, hunger, or sweating in the past month?” and “If you have, how often did you experience those symptoms?”

Fatigue assessment

Fatigue refers to abnormal exhaustion, lack of stamina to complete a task that requires continued efforts and attention, or a decrease in physical activity ability [16].

In this study, we used Multidimensional Fatigue Inventory-20 (MFS-20) developed by Smets, Garssen, Bonke, and De Haes [17] with the consent of the authors. The tool consists of 20 questions that measure general fatigue, physical fatigue, mental fatigue, reduced activity, and reduced motivation. A 5-point Likert scale ranging from 1 (Yes, that is true) to 5 (No, that is not true) was used. A higher score meant greater fatigue. At the time of development, the reliability and feasibility of tools were secured in the study by Smets et al. [17]. Recent studies recommended using total fatigue summary scores to quantify a patient’s fatigue [18]. The fatigue assessment tool for patients with diabetes was first translated into Korean and later reviewed by a professor who majored in Korean language and literature. Then, the revised version was read by a bilingual professor (Korean and English) from the Department of Nursing, who also compared it to the original English version of MFS-20. Fatigue scores were assumed to display a normal distribution curve (skewness 0.27, kurtosis 0.06). In terms of reliability, Cronbach’s alpha was .82.

Data analysis

The collected data were analyzed using SPSS version 15.0. The general characteristics, fatigue, and hypoglycemia of the target patients were analyzed using frequency, percentage, mean, standard deviation, and scope. With respect to the assessment of hypoglycemia, when the respondents answered “1–2 times” or “2–3 times per month”, the values adopted were 1.5 or 2.5, respectively. The difference in fatigue by general characteristics was analyzed using the t test and analysis of variance. The correlations between fatigue and the variables were analyzed through Pearson’s correlation. The fatigue predictor variables were analyzed using hierarchical multiple regression.

Results

Fatigue according to participant demographics and clinical characteristics

Of the 180 participants, 118 (65.6%) were men. The patients were aged 24–90 years (mean, 58.71 ± 11.01 years). The highest education level was junior college or higher (27.8%), followed by elementary school (26.7%), high school (23.9%), and middle school (21.7%). Most of the participants lived with their spouse (50.6%) (Table 1).

The mean duration of diabetes was 142.79 ± 102.91 months (range, 6–377 months). However, in most of the patients (56.1%), the disease duration was 10 years or longer. The majority of the patients (63.3%) also suffered from concomitant diseases other than diabetes. HbA1c values ranged from 5.50% to 13.2% (M ± SD, 7.24% ± 1.01%) (Table 1).
Fatigue was found to differ significantly according to gender ($p = .004$), age ($p < .001$), educational background ($p = .002$), expected disease duration ($p = .001$), type of treatment ($p = .001$), and the existence of other diseases ($p < .001$) (Table 1).

**Fatigue and hypoglycemia symptom in patients with type II diabetes mellitus**

The participants had mean fatigue and hypoglycemia symptom scores of $2.88 \pm 0.61$ and $6.18 \pm 12.60$, respectively. On average, they experienced hypoglycemia symptoms $6–7$ times per month.

**Factors correlating with fatigue in patients with type II diabetes mellitus**

A significant correlation was observed between fatigue and age ($r = .34, p < .001$), expected disease duration ($r = .37, p < .001$), and hypoglycemia symptoms ($r = .22, p = .004$) (Table 2). In other words, fatigue increased as age, duration of disease, and hypoglycemic symptom frequency increased.

**Factors affecting fatigue in patients with type II diabetes mellitus**

To identify the variables affecting fatigue in patients with type II diabetes mellitus, hierarchical regression analysis was performed. The variables measured on a nominal scale were converted to dummy variables. The independent variables used in regression analysis were gender ($male = 0, female = 1$), educational background, type of treatment ($noninsulin = 0, insulin = 1$), and existence of other diseases ($no = 0, yes = 1$), all of which had showed a statistically significant difference in terms of fatigue. They also included expected disease duration, age, and hypoglycemia symptoms, which were correlated with fatigue according to Pearson’s correlation. The Durbin–Watson test score was 1.998 with no correlations among residuals. The tolerance ranged from 0.70 to 0.96 ($>0.10$) and the variance inflation factor ranged from 1.04 to 1.42 ($<10$), which showed that no variables exhibited multicollinearity. Therefore, it appeared that a regression model would be appropriate. In the analysis of fatigue, only age, entered in step 1, emerged as a significant predictor of fatigue. In step 2, three clinical characteristics were entered. Age and duration of disease accounted for $24\%$ of the variance observed for fatigue ($F = 10.33, p < .001$). Finally, when hypoglycemia symptoms were entered in the last step, age, duration of disease, and hypoglycemia symptoms were significant predictors of fatigue. The variables in step 3 contribute to fatigue $3\%$ more than the variables in step 2 do. The total explanatory adequacy of these factors was $27\%$ ($F = 10.39, p < .001$) (Table 3).

**Discussion**

Recently, the number of patients with type II diabetes mellitus in Korea has been increasing, and fatigue has been the most typical symptom they suffer from. However, studies on fatigue experienced by patients with type II diabetes mellitus are scarce. Therefore, this study is meaningful in that it investigated fatigue and its influential factors in patients with type II diabetes mellitus in Korea. Our findings provide a better understanding of fatigue and establish basic data for nursing intervention.

In this study, the participants scored $2.88$ out of $5$ points for fatigue, which is lower than that reported by Fritschi [8] (3.19 out of $5$) but higher than that reported by Weijman et al. [19] (2.28 out of $5$) in the diabetic patients. Young people and women tend to experience fatigue more often [20]. Therefore, it is reasonable that the values found by Fritschi [8] are higher than those found in this study, because the participants of the former study were female diabetic patients aged $40–65$ years. Studies were conducted outside Korea; therefore, they were not compared owing to differences in the genetic and cultural backgrounds. However, in our

| Table 2 Correlations between Fatigue and Age, Duration of Disease, and Hypoglycemia Symptoms. |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| Variable        | Age             | Duration of disease | Hypoglycemia symptoms |
|                 | $r$             | $p$               | $r$             | $p$               | $r$             | $p$               |
| Fatigue         | .34             | <.001             | .37             | <.001             | .22             | .004              |
study, the degree of fatigue was above average in patients with type 2 diabetes in Korea. An additional investigation on the degree of fatigue by characteristic resulted in the following order: physical fatigue 3.20, reduced activity 3.03, general fatigue 2.96, reduced motivation 2.9, and mental fatigue 2.48. Therefore, it is necessary to fully consider the findings from this study in order to develop a fatigue intervention program for patients with type II diabetes. However, in order to generalize the findings, duplicate follow-up studies are required for confirmation.

In this study, fatigue was significantly higher among female patients, older aged, those with longer expected disease duration, those treated with insulin, and those who were suffering from other diseases. This is in agreement with studies reporting that fatigue is more severe in female patients [21], elderly patients [9], and those who suffer from concurrent chronic diseases [22]. Fatigue was also found to be more severe in those with a lower educational background [9,23]. However, our results are contradictory to studies suggesting that fatigue is more severe in male patients [23] and in those with a higher educational background [20], as well as contradictory to studies reporting that the expected disease duration and age are unrelated to fatigue [24]. However, studies on patients with type II diabetes mellitus are limited, and comparisons were made against participants with different medical conditions. Therefore, further confirmatory studies are needed.

The hierarchical multiple regression analysis performed to identify factors that influence fatigue in patients with type II diabetes mellitus revealed that hypoglycemia symptoms was the significant influencing variables of fatigue, even after controlling for age and duration of illness. Because of lack of comparable previous studies, no direct comparisons can be made of the significance of explanatory power. However, there were several studies on correlation of the hypoglycemia symptoms and fatigue. King et al. [11] reported that nocturnal hypoglycemia among patients with insulin-dependent diabetes mellitus was related with chronic fatigue on the day after the hypoglycemia episode. In their study, participants experienced hypoglycemia symptoms about 6 times per month. Leiter et al. [25] reported that respondents experience hypoglycemia symptoms about 5.5 times per month. Although, they studied the correlation, they did not mention the influence of these factors on fatigue. In our study, we confirmed the influence of hypoglycemia symptoms, age, and disease duration on fatigue as well as correlation. This is noteworthy. Meanwhile, despite the finding in this study that hypoglycemia symptoms are a factor that significantly influences fatigue, the treatment type did not show a significant influence event though hypoglycemia symptoms were the most common problem experienced by diabetic patients undergoing insulin therapy. Such findings are thought to be attributed to the lack of significant differences in hypoglycemia symptoms regarding the treatment type, which is viewed as a result of the self-reported research method of measuring hypoglycemia symptoms. Hypoglycemia was confirmed by Whipple's triad (i.e., hypoglycemia symptoms, a low plasma glucose concentration, and relief of those symptoms when the plasma glucose concentration is raised) [26]. Therefore, it is necessary to check these physiological indexes. Although this is a questionnaire-based retrospective survey, self-reported data collection is still the most feasible approach considering the fact that most patients with type II diabetes mellitus do not self-monitor blood glucose levels. In fact, in these patients, a previous experience of a hypoglycemia symptom is a significant predictor of the incidence of hypoglycemia [27]. If the frequency of hypoglycemia increases, the patients may not be able to detect its symptoms [14], which may further cause significant morbidity [27]. Hypoglycemia symptoms can be exacerbated through patients' ineffective disease management, adverse side effects of medication, and the consequences of complications; thus, it is a variable that can be controlled through effective self-management [28]. Therefore, the significance of the current study lies in considering hypoglycemia symptoms—as a controllable variable—to be one of the variables explaining fatigue in diabetes patients and determining that it is an influencing variable with an explanatory power of 3%. Therefore, health management experts of type II diabetes mellitus should make continuous efforts to control hypoglycemia, to reduce fatigue.

This study has several limitations. First, we did not include other influential factors such as psychological factors, and distress related to the disease. Second, this is a cross-sectional retrospective study performed at a single institution. Third, we did not study the characteristics such as frequency, triggers, and aggravating factors of fatigue in patients with type II diabetes; therefore, the generalization of the results could be limited. Hence, further longitudinal prospective, multicenter studies are needed to overcome these limitations. Despite these limitations, this is the first study to address influence of hypoglycemia symptoms on fatigue in patients with type II diabetes mellitus.

**Conclusion**

The study findings are significant because we investigated fatigue in relation with type II diabetes mellitus and performed hierarchical regression analysis by including hypoglycemia symptoms as a factor associated with fatigue. The hierarchical multiple regression analysis findings revealed the influence of hypoglycemia symptoms on fatigue.

Therefore, in the clinical setting, the diabetic health care provider should consider hypoglycemia symptoms more seriously in patients with type II diabetes mellitus in order to reduce their fatigue. In addition, our data suggests including hypoglycemia symptoms, age, and disease duration in educational program development to relieve fatigue in patients with diabetes.

**Conflict of interest**

The authors have no conflict of interest to declare.
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