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Review Article

Forward and Backward Logistic Regression Analysis to Give the Estimation of Tight Diabetes Control: Review

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Abstract: Poor glycemic control is a major public health problem. In Saudi Arabia, the incidence of poor glycemic control was high among patients with diabetes mellitus. Good glycemic control is a major objective for the prevention or postponement of long-term complications from diabetes. Marker of diabetes control is the glycosylated hemoglobin A1c (HbA1c). The American Diabetes Association (ADA) has designated an HbA1c level of <7% as a goal for optimal blood glucose control. The majority of the population today has poorly understood the implication of statistics in the field of medicine. People often refer to statistics as merely as the science of numbers and that its relationship to another field of sciences is far beyond their knowledge and comprehension. Albeit the fact that absolute certainty in medicine is rare, statistics is still utilized to interpret data. In fact, scientists used different statistical methods to improve medicine. For many years, medicine had evolved and reached its present advancement through studies that used the statistical technique for data analysis. However, in this study, logistic regression analysis, the predictors of poor glycemic control were only positive family history of diabetes (OR=3.45, 95% CI: 1.29-9.18) and on oral hypoglycemic agents (OR=78.14, 95% CI=8.88-687.69), and on insulin/combination treatment (OR=37.57, 95% CI: 4.07-346.55) than diet alone. This rather high proportion of poor glycemic control implies the need for the Diabetic Centre to make an effort to develop continuing educational programs that emphasize lifestyle modification and the importance of adherence to a treatment regimen for glycemic control among diabetic patients. This rather high proportion of poor glycemic control implies the need for the Diabetic Centre to make an effort to develop continuing educational programs that emphasize lifestyle modification and the importance of adherence to a treatment regimen for glycemic control among diabetic patients.

Keywords: Forward LR, Backward LR, Diabetes Mellitus, Obesity, Physical Activities, Logistic Regression Analysis

1. Introduction

According to the World Health Organization [1], diabetes mellitus is one of the most common non-communicable diseases in the world, and its epidemic incidence has placed it at the forefront of public health challenges. In the eastern Mediterranean region, there has been a rapid increase in the incidence of diabetes mellitus, particularly in type 2 diabetes. It is the fourth leading cause of death in the region [1]. This quick reference guide aims to provide a readily accessible overview of the management and care of patients with diabetes mellitus. Centre for Obesity at Monash University reported that obesity is a serious chronic disease leading to or aggravating an array of conditions, such as type 2 diabetes. One marker of diabetes control is glycosylated hemoglobin A1c (HbA1c). The recommended value of HbA1c in a non-diabetic individual is 3.5 - 5.5%, whereas the normal value for diabetic individuals, is less than 6.5% on average

over the previous 8 - 12 weeks, according to the World Health Organization [1]. The American Association of Clinical Endocrinologists recommended HbA1c levels of <6.5% [3]. The American Diabetes Association (ADA) has further designated an HbA1c level of <7% as a goal of optimal blood glucose control [3]. A cure for diabetes mellitus has not been found, but this disease can be controlled by maintaining recommended blood glucose levels and an appropriate weight. Blood glucose levels can be maintained by following a diet designed by clinicians and by eating at regular intervals [2], combined with adherence to an exercise program. A study conducted by [4], reported a systematic review of the effectiveness of a daily self-monitoring test in type 2 diabetes mellitus. The results of 72 randomized, controlled trials were identified. There were positive effects of a daily self-monitoring test on the knowledge, frequency, and accuracy of self-monitoring of blood glucose levels; on self-reported dietary habits; and on glycemic control in studies with a short-term follow-up period of 6 months. With longer follow-ups, the interventions that used regular reinforcement throughout the follow-up were sometimes effective in improving glycemic control. Recent recommendations suggest that to reduce the risk of chronic disease, adults should engage in moderate-intensity physical activity on most days, but preferably all days of the week [3]. A current weight management program can produce a significant reduction in weight and HbA1c compared to standard care [5]. A study [6] indicated that the consumption of low glycemic index, indigenous, carbohydrate-rich Caribbean foods might have a positive effect on glycemic control and on the prevention of diabetes. The effect is noticed in the improvement in glycemic control and a decrease in the cardiovascular inflammatory markers. These results should demonstrate the useful and nutritious use of low glycemic index foods by health care professionals, nutritionists, and diabetes educators to delay or prevent the onset of diabetic complications. Intensive blood glucose control in patients with type 2 diabetes significantly increased treatment costs, but the cost of complications was reduced and the period of time without complications was increased [7]. Patients with poor glycemic control have characteristics of worse quality of life compared to patients with well-controlled diabetes due to complications (e.g., blindness, dialysis, foot ulcer and congestive heart failure). Diabetes is a chronic disease that affects human health on a worldwide scale [8]. It has affected 24.7% of the Saudi population and cost 51 billion Saudi riyals for treatment [9].

2. Problem Statement

Glycemic control is becoming a great concern in managing diabetes mellitus in Saudi Arabia. Poor glycemic control among type 2 diabetes constitutes a major public health problem and is a major risk factor for the development of complications from diabetes. Glycemic control remains the major therapeutic objective for the prevention of complications arising from diabetes mellitus [10]. Several clinical trials have shown that glycemic control correlates with a reduction in the complications due to diabetes [11]. A study in the United States showed that the glycemic control rate declined from 44.5% from 1988 - 1994 to 35.8% from 1999 - 2000 [10]. In the United Kingdom, the percentage of poor glycemic control (HbA1c >7.5%) among patients with type 2 diabetes was 69% [12]. The proportion of poor glycemic control among Jordanian patients with type 2 diabetes was 65.1% (HbA1c >7%) of the 917 patients who participated in the study (OR=7.50, $P \leq 0.0005$) [13]. In Pakistan, the proportion was 46.7% patients with HbA1c levels>7.5% [14]. In Kuwait [15], 66.7% of the patients had HbA1c levels≥8%. In Saudi Arabia, the proportion of poor glycemic control was 73% in type 2 diabetics [16]. It has been reported that glycemic control is a major objective for the prevention or postponement of long-term diabetes complications [17]. A total of 10% of patients in Saudi Arabia exhibited good glycemic control [18]. A study conducted by [19] reported the prevalence of diabetes mellitus was found to be 15.8% (24.2% in males and 11.3% in females), and in a total of 451 test participants, only 23.3% were classified as having good glycemic control. In clinical practice, it is difficult to obtain good long-term glycemic control because poor glycemic control in type 2 diabetes is complex [20]. Despite having ahigh percentage of poor glycemic control, but there have been limited studies on the predictors of poor glycemic control and the medications. Thus, this study was conducted to determine the impact of glycemic control among type 2 diabetes.

3. Conceptual Framework

The American Diabetes Association (ADA) has designated an HbA1c level of <7% as the goal of optimal blood glucose control [3], and the American Association of Clinical Endocrinologists has recommended an HbA1c level of <6.5% [3]. It is remarkable that different positive effects in glycemic control can prevent complications due to diabetes. In this epidemiological study, the effects of these factors have been studied, including the socio-demographic characteristics (i.e., gender, age, income, occupational status and educational level), the medical profile (i.e., age at diagnosis, duration of diabetes, type of treatment, complications and family history of diabetes), dietary intake (backup 24h dietary intake), the level of physical activity (low, moderate and high) and the occurrence of obesity (BMI $\geq$ 30 kg/m). In this study, the extent to which the patients with controlled diabetes were aware of their condition, were being treated with anti-hypoglycemic medications and had their blood glucose level under control was determined to be the indicator of the burden of disease.

4. Discussion

Glycemic control plays a key role in the prevention of long-term complications such as impaired vision (blindness), renal failure, neuropathy and cardiovascular diseases. There

are modifiable and non-modifiable factors that contribute to the etiology of poor glycemic control and influence and increase the proportion of poor glycemic control among patients with type 2 diabetes. This study paper has reported the existing theories on diabetes and glycemic control methods and has shown that lifestyle, socio-demographic characteristics, medical profile, obesity, dietary intake and physical activity factors affect the probability of poor glycemic control and the extent to which the disease progresses and causes complications. These factors were described and analyzed using various variables and the results were explained to show public health policy makers a starting point to direct efforts to help patients be aware of their condition and develop good glycemic control. The poor glycemic control proportion among the respondents was statistically documented in this paper as 76%. A comparable study in Jordon shows the proportion of poor glycemic control among patients with type 2 diabetes was 65.1% (HbA1c >7%) [13]. A study in Pakistan shows that the proportion of poor glycemic control was 46.7% (HbA1c >7.5%) [14], and in Kuwait, the proportion of poor glycemic control was 66.7% (HbA1c ≥ 8%) [15]. These studies show that a number of countries in the eastern Mediterranean region have an identical problem with a high proportion of poor glycemic control. In Saudi Arabia, a study found approximately the same proportion of poor glycemic control among type 2 diabetes (73%) [16]. Clinical studies have shown that glycemic control correlates with a reduction in the complications of diabetes [11].

5. Summary

This study examined whether the presence of some factors increased the likelihood of having poor glycemic control. It also reported the incidence of poor glycemic control, as well as obesity and physical activity, among patients with type 2 diabetes as one of their associated factors. The study population comprised of type 2 diabetes patients, who were diagnosed and registered in the Diabetic Centre for more than three months, were at least aged in 20 years old and were able to walk. The respondents for this study were recruited using a systematic random sampling technique. The data were collected using self-administered questionnaire, and HbA1c levels were collected from patients' files. Height was measured without shoes to the nearest of 0.1 cm using a stand-meter. Weight was measured to the nearest of 0.1 kg on a bathroom scale, with the subject wearing light clothes and no shoes. The BMI was calculated as weight (kg) divided by the square of the height m^2. Meanwhile, the data were analyzed with SPSS tool version 19, where measures of central tendencies and distributions were determined as part of the initial data analysis. Descriptive statistics were conducted on the data to draw the information required to prove or disprove the study hypothesis. Descriptive statistics was based on the Pearson Chi-square test. In addition, the logistic regression model was conducted with entering, forward LR and backward LR models to give the overall prediction, which provided important conclusions based on the data. As expected, the proportion of patients with poor glycemic control in this study was very high 76.4%. The percentage of patients with poor glycemic control was the highest among males (80.9%) aged 60 years and above, (82.8%), who had no formal education (87.5%), are not working (77.9%), and have a monthly income between SR 1000 to 3000 (79.5%). However, there were no significant associations ($p > 0.05$) between gender, age group, the level of education, working status, monthly income or glycemic control. The results showed that there was a significant association between having a family history of diabetes mellitus and glycemic control. The incidence of poor glycemic control was significantly higher in those with a positive family history of diabetes mellitus than in those without a family history of diabetes. The diabetic treatment management results showed that there was a significant association between diabetic management and glycemic control; 64.2% of the respondents were administered the oral treatment, and 85.6% of those respondents had poor glycemic control. The results indicated that there was a significant association between diabetic complications and glycemic control. The analyses showed that the incidence of poor glycemic control was significantly higher among those with one or more complications than in those with no complications ($p < 0.05$). The results indicated that 54.2% of the respondents were diagnosed at age 40 years and older, and 81.6% of those respondents had poor glycemic control. There was no significant association between the ages at diagnosis with poor glycemic control. For the duration of the diagnosis, the results showed that 52.8% of respondents had diabetes for 7 years or longer, and 83.8% of those respondents had poor glycemic control. Poor glycemic control was significantly higher in those who had been living with diabetes mellitus the longest ($p < 0.05$). The results indicated that the proportion of patients with low levels of physical activity was higher among the respondents (96.4%) than among those who engaged in moderate or/and high levels of activity. There was no significant association ($p > 0.05$) between physical activity and poor glycemic control. This study shows that 45% of the respondents were obese (BMI ≥ 30 kg/m2), and 76.2% of those respondents had poor glycemic control. On the other hand, there were 32.8% of respondents with over weight. There was no significant association between different obesity levels and poor glycemic control. The results showed that 52.8% of the respondents had abnormal caloric intake, and 73% of those respondents had poor glycemic control. On the other hand, 47.1% of respondents were with normal calories intake per day. There was no significant association between caloric intake and poor glycemic control. The final results showed the predictors of poor glycemic control. The respondents with a positive family history of diabetes were 3 times more likely to have poor glycemic control compared with to those with no family history of diabetes. Patients who were on oral diabetic treatments were 78 times more likely to have poor glycemic control compared with those undergoing other

diabetic management strategies. Some or most of these associated factors have been supported by other studies [21] and [10] respectively.

6. Conclusion

Statistics has brought medicine a finite justification of its clinical trials, studies, and experiments. Statistics plays an integral part in the field of medicine in various ways. Albeit absolute certainty in this field is very rare may be due to individual differences of the samples. In conclusion in our study, the level of poor glycemic control among diabetes patients was very high; the overall percentage of poor glycemic control was 76%. Factors that influenced with glycemic control were an only positive family history of diabetes (OR=3.45, 95% CI=1.29-9.18) and on oral hypoglycemic agents (OR=78.14, 95% CI=8.88-687.69). Continuous educational programs that on emphasize lifestyle modification with the importance of adherence to treatment regimen would be of great benefit in glycemic control.

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