

# Addition of Insulin to Treatment Regimen in Type 2 Diabetes: The Significance of Age and Duration among Sudanese Diabetic Patients

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## Abstract

**Background:** Type 2 diabetes is a progressive disease and as the result of patient's age and diabetes duration,  $\beta$ -cell ability for insulin secretion deteriorates continually and finally fails to meet body requirement. Intensification of treatment drug regimen including addition of insulin is critical to maintain glycemic target and reduce developing of long-term complications. **Objective:** The main purpose of this study was to investigate the effect of diabetes duration and patients' age on addition of insulin to treatment regimen. **Methods:** A single centre, cross-sectional hospital-based study was done among 351 diabetes Mellitus (DM) patients visiting Ribat University Hospital Diabetic Clinic, Khartoum State, Sudan. Data was collected using constructed, validated and multiple-choice questionnaire. **Results:** From 351 patients enrolled in the study, female were 65.8% and male 34.2%. About 64.4% were on oral anti-diabetic; 35.6% on insulin; about 31.6% shifted to insulin when their ages above 40 years; and 22.8% when diabetes duration was above 5 years. Co-morbidity was 54.4% and 60.2% of patients had hypertension. **Conclusion:** Interactions between age and longer duration of diabetes were mostly significant reasons for transferring patients to insulin. Percent of insulin users and co-morbidity was within international range.

## Keywords

Type 2 Diabetes, Insulin, Duration, Age, Sudanese

## 1. Introduction

Diabetes control is complicated [1] and required continuous assessment from both patients and their specialized medical providers [2]. Although diabetes self-management skills for the Type 2 DM patient are improved with longer disease duration, the challenge to keep the required goal for diabetes control becomes harder. Resistance to medications or abnormalities of insulin production may occur and therefore increasing doses, or additional medications, or even changing treatment plan may be needed over time. This resistance is attributed to the fact that  $\beta$ -cell function deteriorates with time due to lipotoxicity or glucotoxicity [3]. Many studies, including United Kingdom Prospective for Diabetes Study (UKPDS) [4], proved the reduction of beta-cell function is associated to duration of diabetes [4] [5] [6] [7] [8] that requiring intensification of oral therapy, including addition of insulin to treatment regimen, considering patient-centered approach [9].

The incident of diabetes increases with age [10] and according to 2005-2006, the National Health and Nutrition Examination Survey in USA, one third of elderly population were diabetes [11]. There are many reasons related to increased incidence of diabetes among elderly, however the important one is that the  $\beta$  cell proliferative capacity reduced, and in diabetic individuals this effect further aggravated by higher rates of  $\beta$ -cell apoptosis [12]. Several studies revealed that age and diabetes duration are independent predictors for co-morbidity even hyperglycemia does not exist [13] [14]. Due to the progressive decline of  $\beta$ -cell function related to diabetes duration old aging, insulin therapy is more suitable choice in such patients' population with type 2 diabetes if risk of hypoglycemia properly monitored [15].

Studies that discuss the factors associated with diabetes' poor control and importance of intensification of drug treatment are rare and scattered, so carrying out of this study will contribute to effort that improves pharmaceutical patient care and also availability of data that push research in Sudan forward.

## 2. Material and Methods

### 2.1. Patients Characteristics

A cross-sectional study was carried out during six month from August 2012 to February 2013. From 398 patients attending to Ribat University Hospital Diabetic Clinic (RUHDC), 351 type 2 diabetes were recruited in this study.

### 2.2. Inclusion and Exclusion Criteria

All type 2 DM non-pregnant patients taking medications for 3 months or more were included in this study.

### 2.3. Instrument of Data Collection

Multiple-choice questionnaire constructed from recent literature and validated by Ribat University staff members who are expert in diabetes management. Pilot

study carried out through random distribution of ten questionnaire copies to patients who informed first about purpose of this study. After minor changes in questionnaire content, data directly and verbally taken from patients, whilst patients' cards also used to obtain some patients data.

#### **2.4. Assessment of Significant of Age and Duration of Diabetes on Addition of Insulin**

Information including socio-demographic characteristic, diabetes co-morbidity, diabetes duration, patients' life style (exercise and diet program) and medication adherence were obtain from all patients. Poor controlled patients who shifted to regimen containing insulin asked about their life style, medication adherence, before they shifted to insulin, and their ages and diabetes duration at that time were specifically stated.

#### **2.5. Data Analysis**

Data were analyzed, using social package for social science (SPSS) version 16, to assess patient's answers. Descriptive and chi-square statistics were used. The differences considered significant at  $p \leq 0.05$ .

### **3. Results**

From 351 patients seen in the study female were 65.8% and male 34.2%. Patients' ages above 60 years were 48.4% and 44.16% had basic education level (**Table 1**). About 64.4% were on oral anti-diabetic, 35.6% on insulin (**Table 2**). About 31.6% shifted to insulin when their ages above 40 years and 22.8% when diabetes duration was above 5 years. Only 7.4% and 5.7% of insulin users had exercise and diet program respectively (**Table 2**). Co-morbidity was 54.4% and 26.4% of patients with co-morbidity their ages were above 60 years, while 13.9% their diabetes duration was more than 5 years (**Table 3**). Hypertension (60.2%) was the major cause of co-morbidity (**Table 4**).

### **4. Discussion**

Many factors are associated with diabetes poor control including old age, obesity, socio-demographic and economic status, sedentary life style, long duration of diabetes, eating unhealthy food and poor medications adherence. In this study the most two significant factors associated with transferring patients to insulin were advancing age ( $p < 0.001$ ) and duration of diabetes ( $p = 0.012$ ). As guideline in RUHDC patients considered poor controlled if oral treatment intensification failed and A1C target is sustained to be more than 8% then the patient should shifted to treatment regimen consist of insulin.

Intensification of treatment in type 2 diabetes, including addition of insulin to achieve target goals and to avoid long-term complications, is recommended by many research leaders such as UKPDS [4] and American diabetes association [16]. More than one fifth (22.8%) of our patients shifted to insulin when their

**Table 1.** Sociodemographic Characteristics.

| Variable                 | Frequency | Percent |
|--------------------------|-----------|---------|
| total n = 351            |           |         |
| <b>Gender</b>            |           |         |
| Male                     | 120       | 34.2    |
| Female                   | 231       | 65.8    |
| <b>Age</b>               |           |         |
| 20 - 40                  | 86        | 24.5    |
| 41 - 60                  | 95        | 27.1    |
| Above 60                 | 170       | 48.4    |
| <b>Educational level</b> |           |         |
| Basic                    | 155       | 44.16   |
| Illiterate               | 74        | 21.08   |
| High secondary           | 59        | 16.81   |
| University               | 49        | 13.96   |
| Non-formal               | 14        | 3.99    |

**Table 2.** Significance of many variables on transferring patients to insulin regimen.

| Variables                   | Insulin users N (%) | Oral anti-diabetic N (%) | p value  |
|-----------------------------|---------------------|--------------------------|----------|
|                             | <b>125 (35.6)</b>   | <b>226 (64.4)</b>        |          |
| <b>Gender</b>               |                     |                          | 0.035    |
| Female                      | 74 (21.1)           | 69 (19.7)                |          |
| Male                        | 51 (14.5)           | 157 (44.7)               |          |
| <b>Age (years)</b>          |                     |                          | < 0.001* |
| 20 - 40                     | 14 (4.0)            | 72 (20.5)                |          |
| 41 - 60                     | 70 (19.9)           | 25 (7.1)                 |          |
| Above 60                    | 41 (11.7)           | 129 (36.8)               |          |
| <b>Duration (years)</b>     |                     |                          | 0.012*   |
| ≤5                          | 45 (12.8)           | 114 (32.5)               |          |
| 6 - 10                      | 36 (10.3)           | 62 (17.7)                |          |
| Above 10                    | 44 (12.5)           | 50 (14.2)                |          |
| <b>Exercise program</b>     |                     |                          | 0.434    |
| Yes                         | 26 (7.4)            | 44 (12.5)                |          |
| No                          | 99 (28.2)           | 182 (51.9)               |          |
| <b>Diet program</b>         |                     |                          | 0.376    |
| Yes                         | 20 (5.7)            | 32 (9.1)                 |          |
| No                          | 105 (29.9)          | 194 (55.3)               |          |
| <b>Medication adherence</b> |                     |                          | 0.479    |
| Adherent                    | 57 (16.2)           | 100 (28.5)               |          |
| Non adherent                | 68 (19.4)           | 126 (35.9)               |          |

\*Consider being significant &lt; 0.05.

**Table 3.** Effect of diabetes duration and age on presence of co-morbidity.

| Factor                  | Presence of co-morbidity N (%) | No co-morbidity N (%) | p value |
|-------------------------|--------------------------------|-----------------------|---------|
|                         | N = 191 (54.4)                 | N = 160 (45.6)        |         |
| <b>Age (years)</b>      |                                |                       | 0.145   |
| 20 - 40                 | 40 (11.4)                      | 46 (13.2)             |         |
| 41 - 60                 | 58 (16.6)                      | 37 (10.5)             |         |
| Above 60                | 93 (26.4)                      | 77 (21.9)             |         |
| <b>Duration (years)</b> |                                |                       | 0.556   |
| ≤5                      | 88 (25.1)                      | 71 (20.3)             |         |
| 6 - 10                  | 49 (13.9)                      | 49 (13.9)             |         |
| Above 10                | 54 (15.4)                      | 40 (11.4)             |         |

**Table 4.** Type of co-morbidity among type 2 DM.

| Type of co-morbidity    | Frequency | Percent |
|-------------------------|-----------|---------|
| Hypertension            | 116       | 60.7    |
| Ischemic heart diseases | 5         | 2.6     |
| Kidney                  | 2         | 1       |
| Liver                   | 2         | 1       |
| Eye                     | 19        | 9.9     |
| Multiple                | 47        | 24.6    |
| <b>Total</b>            | 191       | 100     |

duration of diabetes was more than five years to protect the patient from long term complication.

Majority of our patients shifted to insulin at age above 40 (mainly 41 - 60) and this consistent with fact that beta cell function decline with age progression [10] [15] [17].

In this study, co-morbidity was slightly more than one half and this result is low than reported by Al Hayek and his colleagues from Saudi Arabia who reported 60.9% had one complication affected the general health [18]. Co-morbidity in our study, although insignificant, was high among patients above 60 years and patients their duration more than 5 years and this consistent with many studies [10] [12] [13] [15] [17].

Several studies [19] [20] [21] revealed hypertension is common co-morbidity among patients with diabetes. A systemic literature review revealed that hypertension rates in most studies presented rates above 50%, and many presented rates above 75% [22]. The prevalence of hypertension in this work was 60.7% and this less than Waly study [19] from Egypt who reported 68%. In contrast our result is high than Al Slail [23] and Almetwazi [24] studies from Saudi Arabia reported 45% and 54.53% respectively.

Although there is marked reduction in risk of eye diseases among patients of diabetes over the last 30 years from 90% to less than 50% still it is great problem [25]. Almost 10% of our patients told they had eye diseases and this consisted within that found in literature such as a systemic review reported by Ruta and his colleagues who stated 27.9% as prevalence of diabetes [26].

Only 1% of our patients had kidney diseases and this result is low than that reported Al-Rubeaan [27] study from Saudi Arabia showed 10.8 % and Farahat study [28] from Egypt reported macro-albuminuria was 12.8% among type 2 diabetic patients.

## 5. Conclusion

Many factors are included in transferring type 2 DM patients; however, interactions between age and longer duration of diabetes were abundant. Percent of diabetes co-morbidity was within international range. With regard to nephropathy and retinopathy, our patients required further more thorough screening.

## 6. Limitation

Although RUHDC is one of the largest centers in Sudan, conducting this study in single centre will not give the complete picture about effect of diabetes duration and patients' age on treatment intensification among type 2 DM in Sudan as a whole, so generalized study funded by considerable organization or research institute is urgently recommended.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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