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Assessment of Knowledge and

Understanding of Glycosylated Hemoglobin

Among Diabetic Patients in Baba Gurgur

Diabetic Center

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ABSTRACT

Background: The glycosylated hemoglobin (HbA1c) test is the most widely accepted laboratory test for assessment long term glycemic control. Patients understanding of (HbA1c) can lead to better glycemic control, which reduce the development and/or progression of diabetic complication.

Aim of study: To assess whether knowledge about (HbA1c) and its target goal is associated with better glycemic control among diabetic patients.

Patients and Method: Cross sectional descriptive study among diabetic patients attending Baba Gurgur Diabetic Center_K1 Hospital _NOC in Kirkuk city from October 2018 to January 2019.

The study included three hundred _fifty patients, (M: F 203:147), were invited to answer a validated questionnaire which assess their awareness and understanding of (HbA1c) and its target goal. Their last (HbA1c) were estimated in center laboratory.

Result: A total of three hundred- fifty (350) patients were recruited in the study, two hundred five (58.6%) were knowing of the term HbA1c coded as (group A), one hundred five (51.2 %) of group A, were knowing HbA1c and its goal coded as (group C) ,remainder one hundred participants (48.8%) were knowing HbA1c ,not knowing goal coded as(group D).The group B included one hundred- forty five participants (41.4%) recognized as un ware of HbA1c. Mean HbA1c was significantly lower in group A compared to group B (7.814 ± 2.077) vs (8.975 ± 1.912), p value <0.000. Mean level of HbA1c in group C significantly lower than group D (7.510 ± 2.140) VS (8.155 ± 1.935), p value < 0.025.

There was a significant differences in mean HbA1c between group A and group B with education, regular monthly income, duration of diabetes, and treatment modality matched subjects. These factors associated with understanding of awareness of HbA1c in glycemic control. No significant association was noted between age, gender, marital state and good understanding of HbAc. In total of 350 participants were recruited in this study, one hundred-ninety four (55.5%) were worker in northern oil company. One hundred-thirty of worker (67.0%) were aware of HbA1c (group A), and sixty-four employer (32.9%), were un aware of HbA1c test.

Conclusion: Maintenance of good glycemic control was seen with increasing level of awareness about HbA1c test.

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Introduction

Diabetes mellitus (DM) turn to critical public health problem due to increase its prevalence, its complications and the nature of the disease .

Recently, high percent is estimated to be (9%) is the international prevalence of diabetes in adults, and ascending prevalence of diabetes is seen in developing countries.(1) With the awful economic development and change in the way of life in human community, diabetic patients' number is obviously increasing . A recent global screening perform in 2013 revealed that the prevalence of diabetes at age (20–79) was 8.3%, and eighty percent (80%) of these patients lived in low- and middle-income countries .(2,3) Diabetes is the major cause of death in the world .(4,5) In 2012, from 3.7 million deaths related to blood glucose level in , diabetes mellitus was the main reason of 1.5 million deaths worldwide and as well 2.2 million deaths were related to increasing risk of cardiovascular disease due to high blood glucose level . (6, 7)

It prospected by 2030 for diabetes to become the 7th leading cause of death in world.(5)

Nowadays, 7.1 million people are suffer from diabetes, and expected to progress to 13.6 million by 2040. (4)

There are 2.6 million people with diabetes in Iraq, 54 % of them do not know they have it. (8, 9, 10)

Diabetes prevalence in Iraq has increased as six-fold from 1980 to 2014, as obesity rates (more than 4.2 million obese adult in 2014). (6, 11)

Study in Basrah (Iraq), manifest that diabetes mellitus affecting one in five adults; this prevalence of diabetes will lead to financial pressure on the health care systems. (12)

Diabetes mellitus and its complications is dramatically increased in Arabic speaking countries (East Mediterranean, Arabic peninsula, and Northern Africa),diabetes is with elevated rate in these regions. (13) Six Arabic-speaking countries (Kuwait, Lebanon, Qatar, Saudi Arabia, Bahrain and United Arab Emirates) are through the world's leader in term of diabetes prevalence: (14)

The United Kingdom (UK) Prospective Diabetes Study proved that prevalence of long-term complications could decrease with intensive glycemic control, (2) the considerable morbidity associated with diabetes emerge from micro vascular and macro vascular complications and reduced the quality of life. (13)

So preserve stable blood glucose levels as near to normal glycemic

range as possible is the standard aim for diabetes treatment .(3)

The glycosylated hemoglobin (HbA1c) test is the most widely accepted, dependable measure for assessment glycemic control in long-term , (HbA1c) test prepare an indicator of mean blood glucose level during the past 2-3 months.(15, 16) . The HbA1c test was approved by the World Health Organization (WHO) for the diagnosis of DM and observing glycemic control in people with diabetes. (17, 18) This test supply significant finding for professional health care worker and patients. There is positive impact on long-term health related to patient's understanding of HbA1c and its target goal . (19)

American Diabetes Association and UK National Institute for Health and Care Excellence guideline advise diabetic patients to be aware of their target and actual HbA1c value; the target for long-term glycemic control in patients with diabetes is aHbA1c value of less than 7%.(20,21,22)

Patient education is an essential element in the management of DM and the American Diabetes Association recommends that all diabetic patient must receive self-management education. (20). The National Standards for Diabetes Self-Management Education (DSME) was founded in 2006, to enclose the

quality of self-management education proffer to diabetic patients with in many scenarios based on scientific evidence.(23) The definition of National Standards for Diabetes Self-Management Education and Support for diabetes self-management education as a cooperative and continuous process designed to activate the skills, progressing of knowledge, and capability that are required for successful self-management of DM .(24)

As the management of patients with DM is multidisciplinary, health education should involve all professionals who preserve a direct contact with the patient: internist, nutritional specialist, nurse working, psychological and social worker. Thus; program of diabetes mellitus education must include adequacy of professional in these field (25)

Improving patients understanding of their HbA1c leads to improved diabetes self-management and bestead glycemic control was shown from scientific evidence t.(17, 26)

Although, many study pointed on different result, that HbA1c knowledge was not correlated with patients' diabetes self-management. (20) So it is important to define whether or not patients' knowledge of their HbA1c is really associated with their self-management and blood glucose levels.

Objectives

- Identify current understanding status among Iraqi diabetic patients.
- Assess if knowledge of HbA1c test and its target goal, impact self-management and their glycemic control.
- Determine the influencing factors on the knowledge of HbA1c between diabetic patients.

Patients and materials

Study setting:

The study was carried out in Baba Gurgur Diabetic Center which is located in the K1 Hospital/ North Oil Company, Kirkuk city. It is receive patients from all parts of Kirkuk governorate. The center was established in 2018 and consists of many rooms(Cardiology, Neuromedicine, Ophthalmology , Orthopedic, Nutrition and Health education program, ECO, ECG, and Laboratory).Each patient has her/his own file). The center has received daily approximately 20-30 diabetic out patients. Data were collected on three days of each week (Sunday, Tuesday, and Wednesday), and patients present on the three days were randomly selected to participate in the study.

Study design:

A descriptive cross sectional study was conducted during October 2018

to January 2019, at the outpatient of Baba Gurgur Diabetic Center.

Sampling:

Three hundred and fifty type I and II adult diabetic patients (203male and 147 female) agreed to participation the study (response rate 100%).

Permission were obtained from administrative authorities of hospital, laboratory prior to data collection.

Ethical approval:

The study was approved by the Research Ethics Committee of the Iraqi Ministry of Health, Health Director of Kirkuk.

Exclusion criteria:

- Patients aged less than 18 years.
- Severely ill patients who could not participated.
- pregnant women
- Patients who within the last 30 days received blood ; and patients with underlying disease, such as hemoglobinopathies and malignancy.

A sample of questionnaire was designed by researcher, after explain the aims of the study and content of the questionnaire to the participant; verbal consent was taken and they were interview in details about socio-demographical information such as age, gender, years of formal education, duration of diabetes, types of treatment and occupation.

The subjects were classified as diabetes mellitus (diagnosed for at least one year or longer) according to the previous laboratory measurement, as well as any special treatment or information retrieved from their medical records.

The consequence of an irreversible non enzymatic glycation of the beta chain of hemoglobin A is Glycosylated hemoglobin (HbA1c) . which gives an inserted index of glycaemia over the entire 120 days life span of red blood cells; it is fact that about fifty percent (50%) of HbA1c is created in the month precede to sampling and twenty five percent (25%) in the month before that. ⁽²⁷⁾ HbA1c is a singular measure which can be done at any time of the day and performed without specific preparation such as fasting. These characters have made it the accurate and acceptable standard for evaluation glycemic control in diabetic people and have resulted in its importance as an good choice for assessing glucose tolerance in people without diagnosed diabetes

Blood sample were collected by phlebotomy to measure HbA1c, using AFIAS-6 (Automated Fluorescent Immunoassay System), ⁽²⁸⁾ in Centre laboratory.

All HbA1c values were given as relative concentration% (Diabetes

Control and Complication Trial), DCCT, aligned result).

A researcher-administered questionnaire was used to test participants knowledge about HbA1c test and their target goal. Each participant was approaching with three questions in the same order ,with open ended choice of answering the question s , participants were asked, (What does HbA1c test mean?) .Participants were classified as having accurate awareness about the test (group A) if they answered it as overall glycemic control test or 2-3 months blood sugar control test. Participants were coded as unaware of the test (group B) if they answered wrongly or if responded said, (I don't know). Participants who were aware of the test were then asked (What is your HbA1c goal? (We categorized the participants as 'aware and goal known' (group C); if they mentioned their target goal as less than 7%. Participants were coded as 'goal not known' (group D) if they answered wrongly their target goal, or if responded said, (I don't know).

The study participants education level was classified in to four groups, group I included those who cannot read or write, group II those with low education (≤ 6 year), group III medium education($6 \text{ year} < \text{education} \leq 12\text{year}$) and group IV with high education (>12 year) . For statistical

purposes, the group II participants and those with medium education were considered one category, while those with 7-12 and >12 years were another category.

The mode of treatment for study subjects were divided to three group, first group on insulin therapy, second group received mixed type of treatment (insulin and oral hypoglycemic drugs), and the third group on oral hypoglycemic drugs (OHD).

The occupation of study participants was categorized in to two groups, coded from 1-2 including: governmental employees (regular monthly salary) as good –middle income group ,and unemployed patient ,financial difference between study subjects rely on this classification.

Statistical analysis:

Data were coded, entered to the Microsoft Excel sheet, cleaned and analyzed using SPSS version 20.0 software program. Two approaches were used; descriptive and analytic, the descriptive approach included the calculation of frequencies, percentages, means, and standard

deviation; while in the second approach group comparisons were done by Students test or by Chi-square test .A (p value) equal or less the 0.05 was considered significant.

Results

A total of 350 diabetic participants were involved in this study, 205(58.6%) group A (Knowing HbA1c), and 145(41.4%) group B (Not knowing HbA1c) with a mean \pm SD of age are 54 ± 8 , 55 ± 9 years respectively ranging from 23 to 80 years. The Table 1 and 2 shows that the males account 123(60%) of the total group A, comparison to female 82 (40%). Among group B 79 (54.4%) were male, and 66 (45.2%) were female. Regarding groups C and D, 66(62.8%), 57 (57%) were male diabetic patients, and 39(36.5%), 43 (43%) were female patients respectively.

There was no significant difference in the age and gender between the participants. The highest proportion of group A (28.2%), was in the age group (50-59) years, while in group B (22%), was in age group (≥ 60).

Table (1): Age-sex distribution for group A and B.

Age group (years)	Group A				Group B			
	Male	%	Female	%	Male	%	Female	%
< 40	8	3.9	5	2.4	6	4.1	1	0.6
40 to 49	26	12.6	15	7.3	19	13.1	13	8.9
50 to 59	58	28.2	43	20.9	27	18.6	20	13.7
≥ 60	31	15.1	19	9.2	27	18.6	32	22
Total	123	60	82	40	79	54.4	66	45.2

Table (2): Age-sex distribution for group C and D.

Age group (years)	Group C				Group D			
	Male	%	Female	%	Male	%	Female	%
< 40	4	3.7	4	3.7	4	4	3	3
40 to 49	15	14.1	4	3.7	19	19	10	10
50 to 59	28	27.3	22	20.7	20	20	21	21
≥ 60	19	17.9	9	8.4	14	14	9	9
Total	66	62.8	39	36.5	57	57	43	43

Figure 1: Shows the details of knowledge about HbA1c test in study subjects. Among 350 participants, 205 (58.6%) participants were aware of the term HbA1c (group A); Out of those who were aware of the term HbA1c, (51.2%) knew their goal (group C), and (48.8%) are aware about HbA1c test but they do not know their goal (group D). One hundred-forty five (41.4%) were coded as unaware of the HbA1c test (group B).

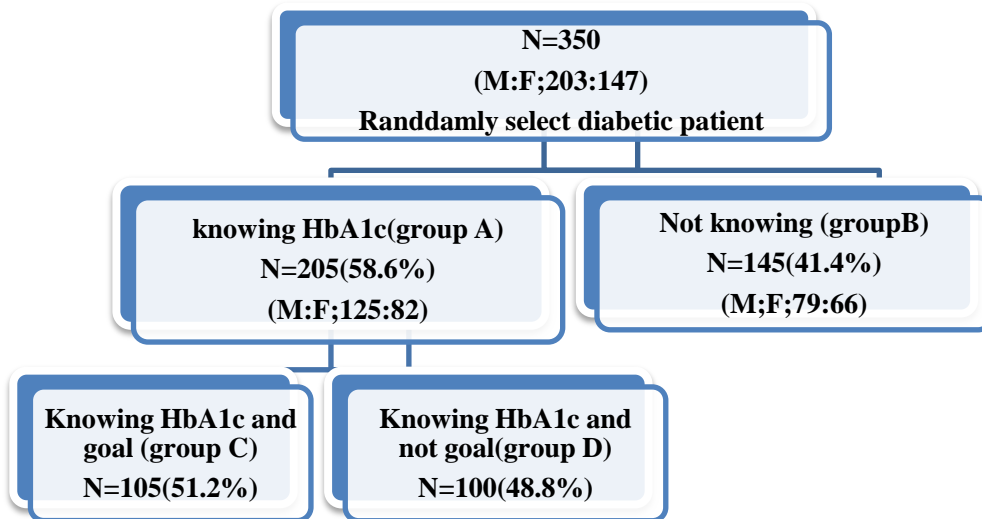


Figure (1): Shows the details of knowledge about HbA1c test among study subjects.

Table 3 and 4 shows the comparison of details of mean HbA1c level in groups subject, the HbA1c% mean level had significantly lower in group A compared to group B (7.8 ± 2.0 vs 8.9 ± 1.9) p value < 0.025 , 51.2% (105) of those who knew their goal were able to maintain their HbA1c% less than 7 (group C).

Table (3): HbA1c% mean level for group A and group B.

Variable No	Group A 205	Group B 145	P value
<i>MeanHbA1c%</i>	7.8	8.9	<0.025
<i>±SD</i>	±2.0	±1.9	

Table (4):HbA1c% mean level for group C and D.

Variable No	Group C No=105	Group D No=100	P value
<i>MeanHbA1c</i>	7.5	8.1	<0.025
<i>± SD</i>	±2.1	±1.9	

In figure (2) results showed that knowledge and awareness about HbA1c test and its target contributed to better glycemic control. Although none of groups reaching actual target goal.

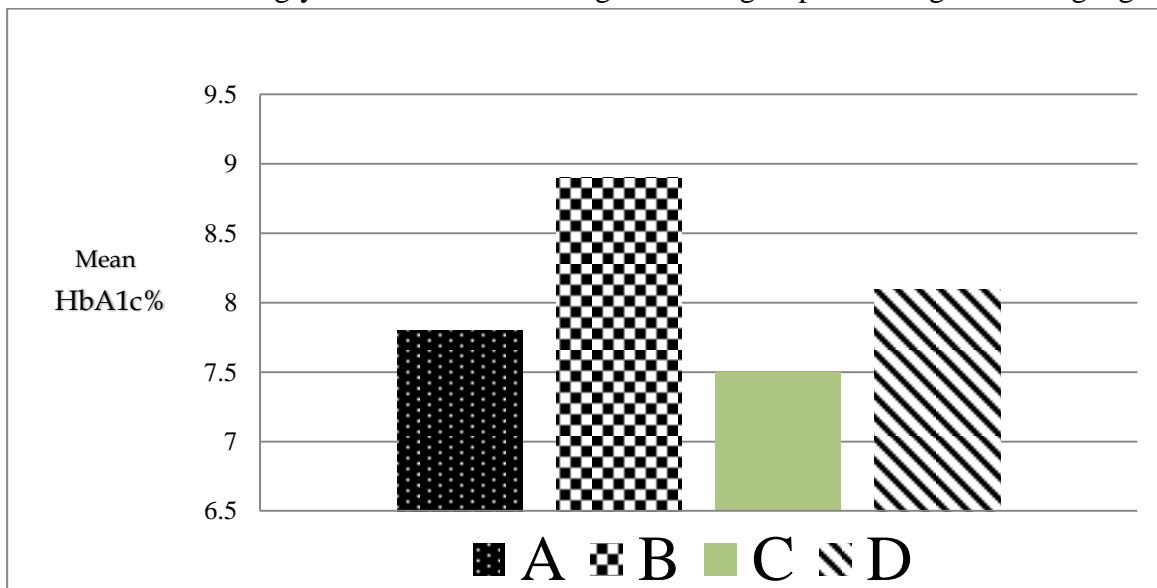


Figure (2): The mean HbA1c% level at different level of awareness about HbA1c test.

Table 5. Shows educational level of study population; the largest proportion of group A were within the group II education; 96(46.8%), and 75 (36.5%) of group A were of institute, university or high education (group III). Mean HbA1c level significantly lower in group III educational; also there were significant differences in mean HbA1c level between group C and group D.

Level of understanding HbA1c significantly increased with level of education in study groups.

Table (5): Educational level for group A and group B.

Level of ducation	HbA1c%	Group A	Group B	P value
<i>Group I</i>	Mean ±SD	8.5±2.1 (No=34)	8.2±2.2 (No=38)	0.71
<i>Group II</i>	Mean± SD	7.9±2.09 (No=96)	9.1±1.8 (No=70)	<0.000
<i>Group III</i>	Mean± SD	7.4±2.09 (No=75)	8.5±2.2 (No=37)	<0.000

Regarding financial status (figure 3), 194 (58.5%) of all participants were governmental employees(regular monthly salary) as example of good-middle income category, 130 (63.4%) of them were within group A; and 64 (44.1%) of employee participants were within group B. proportion of governmental employees subjects (regular monthly salary) is significantly more in group A than in group B .

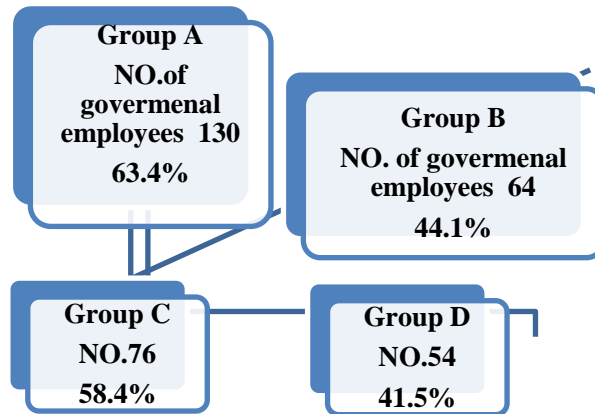


Figure (3): Relation of financial status of participant with regular monthly salary (governmental employers) with understanding of HbA1c.

Table 6 and 7 shows the mean HbA1c% level in relation with type of treatment (for one year); of these 205 patients within group A, 162 patients were prescribed on OHD , 24 patient using insulin and they met significantly lower in mean HbA1c%(p value<0.000); in compare with group B.

Table (6): Relation level of understanding HbA1c with type of treatment in group A &B

Type of treatment	HbA1c%	Group A	Group B	P value
<i>Insulin</i>	Mean ±SD	8.0 2.0 No=24	10.2 1.6 No=21	<0.000
<i>Mixed</i>	Mean ±SD	9.3 2.0 No=19	10.5 2.0 No=12	0.17
<i>OHD</i>	Mean ±SD	7.6 2.0 No=162	8.7 1.8 No=112	<0.000

Table (7): Relation level of understanding HbA1c with type of treatment in group C&D.

Type of treatment	HbA1c%	Group C	Group D	P value
<i>Insulin</i>	Mean± SD	8.8±2.38 No=16	8.49±1.96 No=9	0.641
<i>Mixed</i>	Mean± SD	9.5±1.9 No=8	9.21±2.37 No=14	0.667
<i>OHD</i>	Mean± SD	7.2±2.01 No=81	7.98±1.9 No=77	0.012

In our study the mean duration of disease (diabetes mellitus) in the good understanding group (group A) was 7.6 ±6, which was significantly not related to the level of understanding HbA1c (p value =0.037), and not related to better glycemic control. (Table 8)

Table (8): Distribution of mean HbA1c level with diabetic duration.

Group A		Group B	
Mean duration(year)	Mean HbA1c%	Mean Duration(year)	Mean HbA1c%
7.6	7.8	9.0	8.9

A total of three hundred-fifty (350) participant recruited in our study; one hundred-ninety four (55.4%) were worker in North Oil Company .One hundred-thirty (67%) of worker were aware of HbA1c (group A) and sixty-four (32.9%) were unaware of HbA1c test (figure 4).

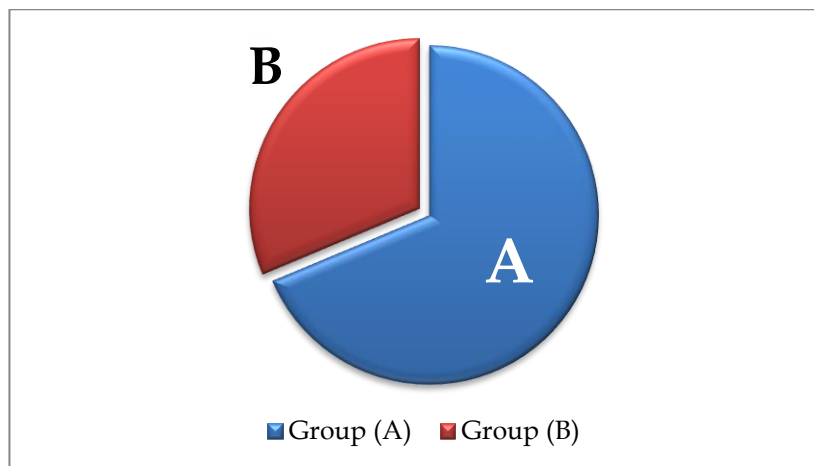


Figure (4): Distribution of North Oil Company Worker according to HbA1c awareness.

Discussion:

HbA1c test is most widely acceptable laboratory test for assessment for long term glycemic control, and it reflects patient control of blood glucose level through several months and has very few acute confounders. (29)

The relationships between glycohemoglobin (HbA1c) and blood glucose concentrations and late complications have been established over the last 30 years. (15) In clinical terms, the UK Prospective Diabetes Study explained that each 1% (11 mol/mol) dropping in HbA1c, reduce the risk of diabetes-related death by 21%, myocardial infarction by 14%, stroke by 12% and micro vascular complications by 37%. (30)

NICE guidelines states that every diabetes patient should have adequate knowledge about HbA1c to allow them to be actively involved in their diabetes management. (21)

Age and sex: - The study results revealed no significant differences of mean HbA1c level for all studied group with age and sex, however patients knowledge about HbA1c test and awareness of their goal; were more common in the age group (50-59) for group A than in other age groups in both sexes, this study is in agreement with the other studies, (26, 31) and it was different from previous studies. (3, 5, 16)

Regarding HbA1c test awareness: - There was a significant difference in mean HbA1c% levels between aware (group A) and unaware (group B) groups. In addition subjects who were aware of HbA1c and their goal had a bested glycemic control (group C), compared to subjects who were not aware or knowing the goal (group D). The present study showed that a large number of diabetic patients knew about HbA1c (58.6%) and nearly 51.2% were aware about their goal also. This rate corresponds to a Malaysia study, (16) in which 60.9% of the patients were rating as having a good understanding of HbA1c. Another study on Indian diabetic patients concluded that 74.2% had high perceived knowledge about HbA1c testing. (26, 32, 33)

A cross-sectional study from United State (31) and China (3) studied the relationship between patient's knowledge of their HbA1c and self-management of diabetes; it was notify that only 25% and 25.3% respectively were accurately knew about HbA1c test.

Socioeconomic status: - The study of association of HbA1c test awareness with socioeconomic status; were analyzed in relation to occupation and education level. There were positive associations between socioeconomic status and HbA1c test awareness; researchers suggest that the HbA1c%

level increase with decreasing socioeconomic status. (14) Study in western population has repeatedly found that rates of unaware about HbA1C are higher in lower socioeconomic groups. (3) Statistical significant association was observed in the current study between level of education and mean level of HbA1c %. Educational level is also a positive predictor of good understanding of HbA1c, as nearly 83.4 % of group A had medium-high education, we had a similar result with many studies ;(2, 5, 15,26) in contrast to study reported that the formal years of education were independently associated with HbA1c knowledge.(34, 35)

Another factor associated with HbA1c test awareness is the *occupation* of the patient, in current study patient groups were categorized in to two groups, good –middle income category government employer (regular monthly salary) and not government employer (no regular monthly salary), or unable to work and/or their income is low., (as no proper acceptable classification of socioeconomic level is available for the Iraqi population). The cost of HbA1c test in private sector lab or the test is not available in primary and secondary health center laboratories as a part of health care system strain and lack in insurance and education plan due to

insufficient government expenditure is financial impact affecting patient awareness about HbA1c. Significant association was observed in the current study between level of understanding of HbA1c and occupation. Out of the total diabetic patients in group A (63.4 %) were governmental employees (good – middle income category) and this result coincided with several studies worldwide, (3, 15, 32, 36) and differed from other studies (26) in which they founded no significant association in between socioeconomic status and HbA1c test awareness. diabetic individual have greater out of pocket medical expenses and a high risk of catastrophic medical spending compared with otherwise similar individuals without diabetes. (36)

These variations in the prevalence of HbA1c test awareness in different countries and within countries might be attributed to the differences in cultural and social habits.

Diabetic treatment: - Lack of education/awareness about diabetes or its treatment is barriers to take medication; although diabetic patients feared the diabetic complications, they didn't know how these occurred and how to manage or avoid them. (37)In our study diabetic patients in group A were using OHD or insulin therapy alone had mean HbA1c% level significantly lower in compared

to group B matched subject.; this result represented the same analyses of large diabetic population which revealed a significant positive relation between the level of adherence and HbA1c goal attainment in USA, (38) Egypt and Saudi Arabia; (25, 30,39) while there is no statistical significances with mean of HbA1c% level and whose were using mixed medication regimen (OHD and insulin). (26) Many studies suggest that a great proportion of people with diabetes have difficulty managing their medication regimen (OHD and insulin), as well as other part of self-management. (39) So understanding of HbA1c test play role in treatment plan achieving good glycemic control; although none of groups reaching actual target goal.

Also diabetic patient using OHD in group C had mean HbA1c% level significantly lower in compared to group D matched subject. Systematic reviews estimated that the total rate of adherence with OHA was 36-93% in retrospective and prospective studies (39) and is 19-46% for insulin only or insulin concomitant therapy. (37)

However some common reasons reported by international literature were not reported by these patients' such as satisfaction and/or lack of social support.

The present study revealed that the *duration of diabetic* disease was

independent predictor for HbA1C awareness, many qualitative studies have been carried in different countries show results approximately are similar to our study; India Tertiary Care Center,(26) Malaysia. (16) The other study had been done in China discovered that patients with longer diabetic duration were in the good understanding of HbA1c group. (3)

Baba Gurgur Diabetic Center is located in K1 hospital within the North Oil Company (NOC), and out of the total participant (194) were worker in NOC; the researches in this study preformed to identify the HbA1c knowledge and understanding between them. One hundred-thirty (67%) of worker were aware of HbA1c (group A) and sixty-four (32.9%) were unaware of HbA1c test.

Limitation

- A part of individual characteristics, like psychosocial effect were not considered in this study, may need to be taken.
- A small percentage of insignificant non-symptomatic complicated diabetic patients may have been incorrectly included to study, because they were not evaluated by specialist.
- In the current study we also aimed to reduce the effects of unknown and uncontrolled confounders by using multivariate analysis and by

using the same study base for both group A and group B.

- Lack of data and classification problems make the income disserved, because of lack of knowledge on how to measure standard of living and which economic deficiency has a direct/indirect effect on health.
- The study was performed in a secondary hospital, thus the finding may not apply to primary care centers.

Conclusion

Education level and governmental occupation (regular monthly income) were important factors associated with understanding of HbA1c. Treatment mode achieving good glycemic control has positive relation with understanding of HbA1c. Maintenance of good glycemic control was seen with rising level of awareness about HbA1c.

Recommendations

- It is hoped that patient's education program on diabetes and their disease markers in particular HbA1c will be emphasized more to those with lower education and income level.
- Post education understanding of HbA1c could also be assess to see whether this would lead to improvement in their glycemic control.

- To raise the awareness of the people about the HbA1c test.
- Necessary lifestyle changes, patient education and self-management important aspects of diabetes care.
- Establishing a secondary prevention program among those with established disease (good quality rehabilitation for all who requires it).
- Screening and treatment of some certain diseases which play as a risk factor in developing DM in healthy population e.g. hypertension and metabolic syndrome.
- Conducting further evaluations and researches on HbA1c test, particularly for subjects, that we cannot be able to obtain sufficient data for analysis.

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References

1. Maria de Fátima Ferreira Grilloa, Cristina RolinNeumanna, Suzana Fiore Scaina,Raquel Farias Rozenoc, Jorge Luiz Grossb,Cristiane Bauermann Leitãob. Effect of different types of self-management education in patients with diabetes. REV ASSOC MED BRAS. 2013; 59(4):400-405
2. International Diabetes Federation. The global burden in: IDF DIABETES ATLAS (sixth edition), 2013; 29–31.
3. Shengnan Yang¹, Weimin Kong, CunyiHsue, Anne F. Fish, Yufeng Chen, XiaohuiGuo,Qingqing Lou¹, Robert Anderson. Knowledge of A1c Predicts Diabetes Self-Management and A1c Level among Chinese Patients with Type 2 Diabetes. PLOS ONE. 2016 March 10; 1371.
4. Kh. ShafiurRahaman, Reza Majdzadeh, KourosHolakouieNaieni, Owais. Knowledge, Attitude and Practices (KAP) Regarding Chronic Complications of Diabetes among Patients with Type 2 Diabetes in Dhaka. Int J EndocrinolMetab. 2017 July; 15(3):e12555.
5. Murray CJ, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet. 2012; 380(9859):2197–223.
6. WHO. Mortality Database. Geneva: World Health Organization; 2016.
7. World Health Organization. Global health estimates: Deaths by cause, age, sex and country. Geneva: WHO; 2012.
8. Report of No communicable Diseases Risk Factors STEPS Survey Iraq 2015.
9. WHO. Global Report on Diabetes. World Health Organization. 2016.
10. International Dabetes Federation. IDF Diabetes Atlas, 7th edn. Bruses, Belgium: International Diabetes Federation, 2015.
11. NCD Risk Factor Collaboration. Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19.2 million participants. Lancet. 2016; 387(10026):1377–1396.

12. Abbas A., Ahmed A., Bashar K., Abdulsatar J., and Khalid Abdulabass M.. Prevalence of diagnosed and undiagnosed \diabetes mellitus in adults aged 19 years and older in Basrah. Iraq diabetes Metab Syndr Obes. 2014; 7: 139–144. Published online 2014; May 2.
13. L. Alhyas, A. McKay, A. Balasanthiran, and A. Majeed, “Prevalences of overweight, obesity, hyperglycemia, hypertension and dyslipidaemia in the Gulf: systemic review,” Journal of the Royal Society of Medicine. 2011; vol. 2, p. 55,
14. Mohammed Badran, Ismail Laher. Type II Diabetes Mellitus in Arabic- Speaking Countries. International Journal of Endocrinology. 2012; 10.1155: 1-2.
15. Beard E, Clark M, Hurel S, Cooke D. Do people with diabetes understanding their clinical marker of long-term glycemic control (HbA1c level) and does this predict diabetes self-care behaviors and HbA1c? Patient Educ and Couns. 2010; 80:227-232.
16. Intan N., Subashini C. ,Wan Mohamad A.. et al . Awareness of Glycosylated Haemoglobin (HbA1c) Among Type 2 Diabetes Mellitus Patients in Hospital Putrajaya. Malaysian Journal of Medicine and Health Sciences. 2015; June 11 (2): 1-8.
17. Karongo C: WHO approved diabetes kit costly for Kenya. <http://www.capitalfm.co.ke/news/2011/01/who-approved-diabetes-kit-costly-for-kenya>.
18. Geoff G: Diabetes diagnosis by HbA1C. Afr J Diab Med 2011; 19(1):3.
19. Duncan Mwangangi Matheka, Jeremiah Munguti Kilonzo, Cecilia Muvenyi Munguti¹, Peter Waweru Mwangi¹ Pattern. Knowledge and practices of HbA1C testing among diabetic patients in a Kenyan tertiary referral hospital. Globalization and Health. 2013; 9:55.
20. American Diabetes Association, Foundations of care: education, nutrition, physical activity, smoking cessation, psychosocial care, and immunization, Diabetes Care 38 (2015) S20–S30.
21. National Institute for Health and Care Excellence. Type 2 diabetes in adults: management. NICE guideline (NG 28). 2019.
22. Carole A. Chivalaa, Dawn Sherrb, Ruth D. Lipmanb. Diabetes self-management education for adults with type 2 diabetes mellitus: A systematic review of the effect on glycemic control. Patient Education and Counseling. 2016; (99): 926–943.

23. Reusch A, Ströbl V, Ellgring H, Faller H. Effectiveness of small-group interactive education vs. lecture-based information-only programs on motivation to change and lifestyle behaviours. A prospective controlled trial of rehabilitation inpatients. *Patient Educ Counseling*. 2011; 82(2):186-92.
24. American Diabetes Association. Standards of medical care in diabetes. *Diabetes Care*. 2017; 40: (Suppl 1):S11-S61.
25. Zahra Khalil Alsairafi, Kevin Michael Geoffrey Taylor, Felicity J Smith, Abudlnabi T Alattar. Patients' management of type 2 diabetes in Middle Eastern countries: review of studies. *Patient Preference and adherence*. 2016; 10: 1051-1062.
26. Satyavani Kumpatla, Srikanth Medempudi, Deepa Manoharan, and Vijay Viswanathan. Knowledge and Outcome Measure of HbA1c Testing in Asian Indian Patients with Type 2 Diabetes from a Tertiary Care Center. *Indian Journal of Community Medicine: Official Publication of Indian Association of Preventive and Social Medicine*. 2010 Apr; 35(2):290.
27. Saeed Akram Bhatti, Abdul Haseeb Khan, Naem Yaqoob. Glycated Hemoglobin (HbA1c); screening for undiagnosed diabetes in healthy individuals in Sargodha. *The Professional Medical Journal*. 2015; 22(2):208-214.
28. AFIAS-6 Boditech Med Inc. 2018. www.boditech.co.kr Eng. analyzer.
29. Karlypippitt, Marlana LI, Holly E. Gurgle. Diabetes Mellitus: Screening and Diagnosis. *Am. Fam. Physician*. 2016; 93(2):103-109.
30. Jason Gordon, Phil Mc Ewan, Iskandar Idris, Marc Evans, Jorge Puelles. Treatment choice, medication adherence and glycemic efficacy in people with type 2 diabetes: a UK clinical practice database study. *BMJ*. 2018 April; 6: e 000512. doi: 10.1136.
31. Heisler M, Piette JD, Spencer M, Kieffer E, Vijan S. The relationship between knowledge of recent HbA1c values and diabetes care understanding and self management. *Diabetes Care*. 2005; 28:816-22.
32. Caroline Bowler, Ruth Erde, Parijat De. An evaluation of knowledge and understanding of HbA1c in diabetes patients in a secondary care setting. *Society for Endocrinology*. 2014 Mar; 24-27.
33. Trivedi H, Gray LJ, Seidu S, et al. Self-knowledge of HbA1c in people with Type 2 Diabetes

- Mellitus and its association with glycaemic control. Primary Care Diabetes Europe. 2017 Oct; 11 (5): 414-420.
34. Michele Heisler, John D. Piette, Michele Spencer, Edie Kieffer, Sandeep Vijan. The Relationship Between Knowledge of Recent HbA1c Values and Diabetes Care Understanding and Self-Management. Diabetic care. 2005 April; 28(4):816-822.
35. N Bhurji, J Javer, D Gasevic, N A Khan. Improving management of type 2 diabetes in South Asian patients :a systematic review of intervention studies. BMJ. 2016; 6:e008986.doi:10.1136.
36. Crystal M, Smith-Spangler, Jay Bhattacharya, Jeremy D, Goldhaber-Fiebert. Diabetes, Its Treatment, and Catastrophic Medical Spending in 35 Developing Countries. Diabetes Care. 2012 Feb; 35(2):319-326.
37. Fatima B Jeragh- Alhaddad, Mohammad Waheedi, Nick D Barber, Tina Penick Brock. Barriers to medication taking among Kuwaiti patients with type 2 diabetes: a qualitative study. Patient Preference and Adherence. 2015;9; 1491-1503.
38. Heather P. Whitley, Joli D. Fermo, Kelly Ragucci, Elinor C. Chumney. Assessment of patient knowledge of diabetic goals, self-report medication adherence, and goal treatment. Pharmacy Practice. 2006; 4(4):183-190.
39. Joyce A. CRAMER. A systematic Review of Adherence with Medication for Diabete. Diabetes Care. 2004 May; (27): 1218-1224