

# Association of Glycosylated Hemoglobin with Physical Activity and Diet in Sudanese Non-Diabetics Population

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Page No.: 14-18 Volume: 1, Issue 2, 2020 ISSN: 2708-2709 Journal of Diabetes Metabolism and Endocrinology Copy Right: Medwell Publications Abstract: Glycated Hemoglobin (HbA<sub>1c</sub>) is now used largely for DM control. HbA<sub>1c</sub> is influenced by many risk factors; these include Body Mass Index (BMI), physical activity, age, ethnicity, diet, smoking and Blood Pressure (BP). Previous studies showed that the levels of  $HbA_{1c}$ showed different relationship with physical activity and diet. The objective of this study is to investigate the physical activity and diets as determinants of glycated hemoglobin in non-diabetic Sudanese population. A cross sectional study was conducted during 2016-2018 in Sudan covering Khartoum state, Northern state, Gezira state, Red Sea state and North Darfur state, on adults of ages between 20-60 years and not known to be diabetic or suffering from any chronic illness. The 1096 participants were assessed by a questionnaire covering age, gender, dietary intake in the previous month, physical activity and other demographic and social characteristics. BMI and BP were calculated by standard scales. A sample of 5 mL venous blood was taken for FBG to exclude DM and measurement of HbA<sub>1c</sub> using a modified ELISA reader known as Cobas Integra 800 (Roch) machine. Correlations between the variables were estimated and p<0.05 was considered statistically significant. The overall mean value of  $HbA_{1c}$  was  $4.6\%\pm0.9$  with a minimum value of 1.2% and maximums of 6.3. At 95% confidence interval the lower bound Mean was 4.5% and the upper bound mean was 4.7%. The mean age of the participants was found to be 25.1±9.2 years with a range of 20-60 years. The mean of BMI was found to be  $22.8\pm4.8$  with a minimum of 18.5 and maximum of 51.4. 497(45.3%) of the participants were physically active. The physical activity level negatively affected HbA<sub>1c</sub> (p = 0.004). The level of HbA<sub>1c</sub> is lower in physically active participants than non-active participants this study showed that there was no correlation between daily caloric intake and the level of HbA<sub>1c</sub>. There was no correlation between HbA<sub>1c</sub> and carbohydrate (p = 0.18), Protein (p = 0.16) and Fat (p = 0.12). In conclusion HbA<sub>1c</sub> level is decreased by physical activity and not affected by dietary intake. Health education and increase

# **INTRODUCTION**

Hemoglobin  $A_{1c}$ (HbA<sub>1c</sub>) is a glycated hemoglobin formed by the glycosylation of hemoglobin. The term 'glycosylated' was used initially but it has been pointed out that this term strictly refers to glycosides. Therefore, the Joint Commission on Biochemical Nomenclature has proposed that the term 'glycation' is appropriate for any reaction that links a sugar to a protein or in the particular case of a reaction with hemoglobin, the term 'glycated hemoglobin'<sup>[1]</sup>. Its value represents the glycemic status of a person over the last two to three months.

The normal lifespan of an erythrocyte is 120 days. In the presence of hyperglycaemia as the erythrocyte circulates, the N-terminal valineresidues of beta chain of haemoglobin, gradually, under goes non enzymatic glycation.

The HbA1C thus formed, constitutes about 60-80% of the total glycatedhaemoglobin. The glycation of haemoglobin occurs over the entire 120-day life span of the erythrocyte<sup>[2]</sup>.

Gulliford and Ukoumunne found a 0.180% lower HbA<sub>1c</sub> in participants who were active compared with the inactive participants and HbA<sub>1c</sub> gradually decreases with increasing level of physical activity<sup>[3]</sup>. But other studies done by Boeing *et al.*<sup>[4]</sup> found no association between the level of physical activity and HbA<sub>1c</sub><sup>[5]</sup>.

The effect of diet on  $HbA_{1c}$  level have been studied by many researchers. Boeing *et al.*<sup>[5]</sup> studied the association of diet and other lifestyle factors with  $HbA_{1c}$ in a non-diabetic adult population and found that there was direct relation between the risk of increased  $HbA_{1c}$ and high energy and energy-adjusted saturated fat intakes.

A study performed by Modan *et al.*<sup>[4]</sup> found no correlation between the intake of any specific food component and  $HbA_{1c}^{[6]}$ . Also, Harding *et al.*<sup>[6]</sup> found independent associations between  $HbA_{1c}$  concentration across the normal range of  $HbA_{1c}$  and both total fat intake and the pattern of dietary fat intake<sup>[6]</sup>. Alcohol intake was associated with lower  $HbA_{1c}$  level an association not explained by confounding variables. The distinction between type of alcohol consumed was particularly important in men<sup>[7]</sup>.

# MATERIALS AND METHODS

A cross sectional study was conducted during 2016-2018 in concomitant with another study on

the awareness of the beneficial effects of practicing physical activity, sport and encouraged smoking cessations is very important to control glycemic index, especially in diabetic patients and obese subjects.

healthy sudanese subjects of both sexes with age group 20-60 years. 1163 Healthy Sudanese adult volunteers were included and the study covered Khartoum state, Northern state, Gezira state, Red Nile state and North Darfur state.

The exclusion criteria of this study included: Pregnant ladies, abnormal Fasting Blood Glucose (FBG), Diabetes mellitus, Hypertension, Renal failure, Liver disease, Cancer, Chronic diseases (cardiac diseases, TB, asthma, thyroid disorders), Hematological disorders, Recent acute diseases (Malaria, typhoid fever..), Lactation., History of recent surgery or splencetomy, History of schistosomiasis, hemoglobinopathies, blood disorders and Subjects not consenting. Written consents were obtained from all participants after fully explaining to them the project.

A questionnaire was filled by all volunteers to obtain the data about name, age, address, medical history, drug use,dietary intake in the previous month, physical activity and lifestyle. Weight, height and blood pressure were measured with standard techniques. Complete clinical examination was performed.

After informed consent; 5 mL of venous blood was collected by a standard procedure from each participant under complete aseptic conditions in the morning and after an overnight fasting 0.2.5 mL was placed in fluoride oxalate containers and then used for FBG measurement with auto analyzer A 15. The remaining 2.5 mL was placed in EDTA container and used for HbA<sub>1c</sub> analysis. (Icteric, lipemic, hemolyzed or bacterially contaminated samples were not used).

HbA<sub>1c</sub> was measured using modified ELISA reader known as COPAS Integra 800 using commercial reagent kits from Roche Company. All techniques and equipment were standardized. All data collected in this study was analyzed using the SPSS computer programs.

Correlation coefficient (r) was used for continuous numerical variables and student t test and (ANOVA) statistics was used for categorical variables.  $p \le 0.05$  was considered significant.

**Ethical consideration:** Ethical Approval of this study was obtained from the Federal Ministry of Health in Sudan (FMOH) and The National Ribat University (NRU). The objectives of the study were explained to all individuals participating in the study. An informed consent was obtained from each participant in the study.

Gender	Frequencies							Percentage
Male	272							24.8
Female	808							73.7
Missing	ing 16							
Total	1096							100.0
Table 2. I	Decorrintivo et	atistics of A so 1	DMI Dulco ro		PG and UbA of the a	tudied population	(n - 1006)	
Table 2. 1 Test	Mean		SD	SE of n	nean Medi	ian	Minimum	Maximum
Age	25.1		9.2	0.27	21.	0	20	60.0
BMI	22.8		4.8	0.15	22.0	0	0.24	51.4
HbA <sub>1c</sub>	4.6		0.98	0.03	4.7	5	1.2	6.3
Table 3: Physical activity and Mean of Hb A <sub>1c</sub> levels Physical				(n = 1096) Confidence interval for mean 95%		Confidence interval for mean 95%		Sig. t test
activity	Mean	SD	SE	Lower bound		Lower bound		p-values
Yes	4.5980	1.04323	0.04828	4.5031		4.5031		0.004
No	4.6913	0.89641	0.04117	4.6104		4.6104		
Table 4: H	IbA <sub>1c</sub> in relat	ion to amount of	f diet (Mean±	SD)				
Diet		Khartoum stat	te Red	sea state	North Darfur state	Gezira state	Northern state	Sig. t test
Carbohydrate/gram		170.54(2.13) 152.5		54(1.13)	194.54(3.23)	168.54(1.19)	200.54(3.53)	0.18
Protein/gram		51.18(0.76)	51.18(0.76) 59.3		34.26(1.26)	48.87(1.56)	31.26(1.23)	0.16
Fat/gram		45.20(0.67)	40.1	33(0.77)	29.20(0.12)	39.20(1.47)	28.20(0.61)	0.12

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#### **RESULTS AND DISCUSSION**

Table 1: Distribution of studied population according to gender in the study

A total of 1096 volunteers were identified as eligible; according to the inclusion criteria and approved to be enrolled after filling the consent, questionnaire and were fit on the physical examination. About 67 subjects (5.7%) were excluded due to high Fasting Blood Glucose (FBG) and they were not known to be diabetics. About 808(73.7%) of the study sample were females and 288(24.8%) were males.

The mean age of the participants was found to be  $25.1\pm9.2$  years with a range of 20-60 years. The mean of BMI was found to be  $22.8\pm4.8$  with a minimum of 18.5 and maximum of 51.4 (Table 1 and 2). About 196(17.9%) of the participants have a BMI <19, 630(57.7) have a normal BMI between 19-24.9, 189(17.2%) are overweight with BMI between 25-30 and 81(7.4%) are obese with BMI >30 (Fig. 1).

The overall mean value of HbA<sub>1c</sub> was  $4.6\% \pm 0.9$  with a minimum value of 1.2% and maximums of 6.3. At 95% confidence interval the lower bound Mean was 4.5% and the upper bound mean was 4.7% as shown in Table 1 ande 2. There was insignificant difference between HbA<sub>1c</sub> levels and age (p = 0.177). The oldest (>50 years) having the lowest values 4.4% and those with group of age between 35-50 years have the highest value 4.7%. There was no correlation between Hb A<sub>1c</sub> and carbohydrate (p = 0.18), Protein (p = 0.16) and Fat (p = 0.12) (Table 3 and 4). Figure 2 phisical activity and excercise in the participants of the study sample (n = 1096).

HbA<sub>1c</sub> measurement is one of the diagnostic tests used in the diagnosis of diabetes and monitoring managing hyperglycemia in uncontrolled diabetic



Fig. 1: Distribution of studied population according to BMI in the study; Series 1



Fig. 2: Phisical activity and excercise in the participants of the study sample (n = 1096)

patients.  $HbA_{1c}$  is a relevant predictor of diabetes related complications and of mortality<sup>[8]</sup>. As  $HbA_{1c}$  is now used largely for DM control, the normal values of  $HbA_{1c}$  in Sudanese have been addressed by this study.

The reference values of  $HbA_{1c}$  currently used in Sudan have been adopted from textbooks or guidelines referring mainly to European or American populations but the normal Sudanese reference intervals of hematological values<sup>[9-12]</sup>, respiratory function tests parameters<sup>[13]</sup> Renal functions test<sup>[17]</sup>, serum electrolytes<sup>[15]</sup> and mean of glycated Hemoglobin (HbA<sub>1c</sub>)<sup>[16-20]</sup> have been found to be different from Caucasian reference values.

The purpose of this study was to establish the normal reference range for  $HbA_{1c}$  in Sudanese non-diabetic adults. Evermore, the study was designed to see the influence of exercise, physical activity and diet on the  $HbA_{1c}$  level.

In the previous studies there was conflicting data regarding daily caloric intake and the level of HbA<sub>1c</sub>. this study showed that there was no correlation between daily caloric intake and the level of HbA<sub>1c</sub>; these findings were in agreement with those obtained by Modan *et al.*<sup>[4]</sup> and Harding *et al.*<sup>[5]</sup> but these findings were disagreement with Boeing *et al.*<sup>[5]</sup> who found that there was a direct relation between risk of increase HbA<sub>1c</sub> and high energy and energy adjusted saturated fat intakes. In this study, the physical activity level negatively affected HbA<sub>1c</sub> (p = 0.004).

The level of  $\text{HbA}_{1c}$  is lower in physically active participants than non-active participants. These findings were in agreement with Ali *et al.*<sup>[16]</sup> and Gulliford *et al.*<sup>[3]</sup> who reported negative association between physical activity and HbA<sub>1c</sub>. No correlation between the physical activity and HbA<sub>1c</sub> was reported by Boeing *et al.*<sup>[5]</sup>, Modan *et al.*<sup>[4]</sup> and Fadul *et al.*<sup>[17]</sup> and the findings of the current study were in disagreement with them.

#### CONCLUSION

The mean of HbA<sub>1c</sub> in healthy non-diabetic Sudanese people at CI 95% is 4.6% and the normal range value for HbA<sub>1c</sub> is between 1.2 and 6.3%. Healthy non-diabetic Sudanese people have lower HbA<sub>1c</sub> concentrations than the international Caucasian and the international normal references of HbA<sub>1c</sub> cannot be applied in Sudanese population because of the difference between values.

Health education and Increase the awareness of the beneficial effects of practicing physical activity, sport and encouraged smoking cessations is very important to control glycemic index, especially in diabetic patients and obese subjects.

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