Normal values of Hemoglobin A\textsubscript{1c} (Hb A\textsubscript{1c}) in non-diabetic adults

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Abstract - Background: At present, there are no studies done to investigate the normal values of Hb A\textsubscript{1c} in Sudanese population. The level of Hb A\textsubscript{1c} for Sudanese population is borrowed from international references.

Objectives: The objective of this article is to investigate the normal levels of Hb A\textsubscript{1c}, and the factors that may affect its value.

Methods: Extensive internet search has been done on research regarding the normal values of Hemoglobin A\textsubscript{1c} and factors affecting them in non-diabetic Adults.

Result: Normal level of Hb A\textsubscript{1c} obtained from all previous studies showed a value of 3.6\% as minimum and 6.5\% as maximum value. Significant racial/ethnic differences in Hb A\textsubscript{1c} levels were observed; these differences are significantly higher in people from African descent than in Caucasians.

Discussion: Hb A\textsubscript{1c} is influenced by many risk factors; these include BMI, physical activity, age, ethnicity, diet and smoking.

Conclusion: Normal level of Hb A\textsubscript{1c} from all previous studies showed a value of 3.6\% as minimum and 6.5\% as maximum value and seemed to be affected by many risk factors.

Index Terms - Hb A\textsubscript{1c}, Normal value, non-diabetic Adults

I. INTRODUCTION

Currently, there are no known studies conducted to investigate the normal reference range of Hb A\textsubscript{1c} in Sudanese population. These normal reference ranges of Hb A\textsubscript{1c} for our population in the clinical practice are taken from non-Sudanese subjects depending on the international American and British Guidelines.

Most of the studies about the normal Hb A\textsubscript{1c} were done in Western countries. For these countries the different environment, ethnic groups, nutritional habits and body mass indices, play a significant role in determining the Hb A\textsubscript{1c} levels compared to Sudan.

II. METHODS

An extensive internet search regarding the normal values as well as the factors affecting Hemoglobin A\textsubscript{1c} in non-diabetic Adults, has been conducted.

Consulting the following Web site: National Center for Biotechnology Information NCBI, PubMed, Google Scholar and using the following key words: Normal Hb A\textsubscript{1c}, Normal Hb A\textsubscript{1c} in non-diabetics, physiological factors affecting Hb A\textsubscript{1c}.

The search covered the past 28 years and 13 papers were located and retrieved.

III. RESULTS

IV.

<table>
<thead>
<tr>
<th>First author</th>
<th>Type of study – country</th>
<th>Sample size</th>
<th>Date</th>
<th>Results and main conclusion</th>
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<tbody>
<tr>
<td>Modan\textsuperscript{1}</td>
<td>Cross section – Israel</td>
<td>648</td>
<td>1988</td>
<td>Correlation of Hb A\textsubscript{1c} with daily caloric intake and physical exercise was not established. No significant correlation between BMI and Hb A\textsubscript{1c} was observed. A small, yet significant elevation in Hb A\textsubscript{1c} was related with smoking (7.1 vs. 6.8%, \textit{P}&lt;.01)</td>
</tr>
<tr>
<td>Simon\textsuperscript{2}</td>
<td>Cross section – United Kingdom</td>
<td>3240</td>
<td>1989</td>
<td>Mean of normal distribution of Hb A\textsubscript{1c} in men is 5.03% with mean (SD) of (0.53) Obese persons (defined as BMI &gt; 28 kg/m\textsuperscript{2}) were found to have higher level of Hb A\textsubscript{1c}; however after adjustment for age, the correlation between the two values (BMI and Hb A\textsubscript{1c}) was no longer significant.</td>
</tr>
<tr>
<td>K. Wiener \textsuperscript{3}</td>
<td>Cross section – Liverpool, UK</td>
<td>399</td>
<td>1999</td>
<td>No significant correlation between HbA\textsubscript{1c} and age; hence, they cannot see the need for age-specific reference ranges for Hb A\textsubscript{1c}.</td>
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</table>

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From all the studies done about normal level of Hb A₁c, the minimum value was 3.6 % and the maximum value was 6.5 % (2,7,10,12). There are significant racial/ethnic differences in Hb A₁c levels, which are significantly higher in Blacks than white (4,11).

Hb A₁c increased with all the known risk factors for diabetes (e.g., obesity) (2,5) and decrease with increase in physical activity (7), but the age, diet and smoking appeared as a factor influencing Hb A₁c independently (1,2,3,5,6,7,8).

VI. CONCLUSION

By reviewing all the previous studies, blood levels of Hb A₁c demonstrated values of 3.6% as minimum and 6.5% as maximum value (2,7,10,12).

REFERENCES


[5] Boeing H, Weisgerber UM, Jeckel A, Rose HJ, Kroke A. Association of smoking exposure as measured by pack-years was detected as well.


V. DISCUSSION

Hb A₁c level showed significant racial/ethnic dependency where it was significantly higher in Blacks and Hispanics.

There is a direct relationship between risk of increased Hb A₁c and the intake of high energy and energy-adjusted saturated fats. Hb A₁c levels did not correlate with physical activity. Obesity was related with higher Hb A₁c levels.

A dose-response relationship between HbA₁c levels and the daily smoked cigarettes was observed. A positive association with total smoking exposure as measured by pack-years was detected as well.

The study detected a Hb A₁c mean of normal distributionin general population to be 6.34 % with mean (SD) of (0.85). Found a 0.180% lower Hb A₁c in participants who exercise compared to those with no or little physical activity; Hb A₁c seemed to be correlating with the level of physical activity. Smoking had a direct association with higher Hb A₁c levels.

They stated that the results established clearly an Hb A₁c increment in correlation with age, despite the multivariate adjustments for sex, fasting, and 2-hour post-load glucose; and suggested that other factors not related to glycaemia may weigh in the relationship of Hb A₁c with age.

Hb A₁c is helpful diagnostic value in diabetes the diagnose can be established when the Hb A₁c level is 6.5% and more.

Hb A₁c levels were found to be higher in people from African descend than in Caucasian people across the full spectrum of glycaemia after adjustments for plasma glucose and other factors known to correlate with Hb A₁c levels.

Normal range of Hb A₁c test for non-diabetic people is between 3.6 – 5.5 %.

Hb A₁c of 6.5% was recommended as the diagnostic cut-off point for diabetes.


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