# ORIGINAL

# Reference Values of Some Biochemical Parameters in Adult Population of Bahrain (Part - I)

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ALL laboratory reports contain range of normal values i.e. reference values for each test performed in the laboratory for comparison of the obtained data of the individual. The results are considered as "normal" if they are within this range and "abnormal" when they are outside the range. Based on the laboratory results, the Physician would either confirm their clinical diagnosis or the data should help him to arrive towards a diagnosis. The results are important for the follow up and treatment of patients. The validity of results depend on consistent reports and the confidence that the reference values reflect on the values expected in the healthy population to which the given individual belongs and on whom the tests were requested. To establish a reference value for a given parameter analysed in a laboratory is a challenging task because multiple factors are to be considered before the reference value can be established for a given parameter. Determination of reference value should take into account all those factors which potentially affects the test values. These include age, sex, race, nutrition and environmental/geographical influence and many others. Young (1) classified these factors into two groups. Firstly, long term physiological influence which includes aging, geographical location and environment in which an individual resides and his habitual diet is considered. Secondly, short term physiological influence which include the effects of recent food intake, smoking, posture and time of day of sample collection. Short term physiological influence reflect immediate alteration of blood composition for certain constituents eg. recent food intake may change the levels of blood sugar, cholesterol, triglycerides and urea. Time of sample collection is also important due to circadian variations of many constituents such as hormones (2).

The method of sample collection, storage, transportation and analysis are characteristic for a given laboratory and have profound effects on the composition of blood.

The aim of this study is to establish the reference values of some parameters of biochemical importance analysed in the laboratory of Salmaniya Medical Centre, the main reference hospital in Bahrain. The influence of various physiological factors such as age, sex, food habits, drinking water and other environmental factors in addition to genetic influence on various blood constituents will also be studied.

## MATERIAL AND METHOD

500 adult Bahrainis of either sex and in the age group of 16 - 27 years were chosen for the present study. A careful case history of each was recorded (Table 1). The majority of the cases (362) were students. Age, sex, body weight, food habits, socio-economic status, family history were recorded in addition to their habits — smoking, alcohol intake, drugs and type of water (Hard/Soft) for drinking and cooking used were also noted. From the case history we found that the majority of them (470) were of normal physique (height/-body weight), all non-smokers, none on alcohol and all belonged to average socio-economic status. None of them had major disease and all belonged to same ethnic

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background. For the hormonal studies (not reported in the present paper) last menstrual period dates for women were also recorded.

The work was planned in groups of 20 - 30 samples at a time. All were briefed about the nature and importance of work. Overnight fasting blood samples 20 - 25 mls. were collected between 8 - 9 A.M. The samples were sub-divided according to analysis requirements. The samples were analysed along with routine hospital samples by unbiased laboratory technicians. The sample collection, storage, transport, method of analysis were all identical to routine work of the laboratory. The samples were analysed along with those of patients. The whole concept was to have identical treatment with samples for patients. In this way all sources of analytical and non-analytical errors were common in healthy subjects and patient's samples. All results were compiled and statistical analysis was done taking into consideration all factors responsible for analytical and non-analytical sources of errors (3, 4). Variation within the batch, batch to batch, methodology and machine were taken into account (5 - 7).

## RESULTS

The results are shown in Tables II, III and IV. The mean of each analyte was calculated. The results showed Gaussian distribution around the means. The range is obtained from Mean $\pm$ 2 SD, which covers 95% of the cases. The Salmaniya range (population range) is calculated for comparison of values by obtaining mean value in hospital population results of each analyte leaving cut off values. The range is obtained from Mean $\pm$ 2 SD (8). In the last column reported, values of these analyte in literature is given for comparison (9).

### Plasma Glucose

The most interesting finding is plasma fasting glucose. The range found in the healthy subjects is between 82 - 114 mgs/dl.

### Cholesterol and Triglycerides

Serum cholesterol in normal subjects was found to range between 95 and 235 mgs/dl. and of triglycerides between 10 - 130 mgs/dl.

### Uric Acid and Inorganic Phosphorous

Uric acid range of values for males were between 2.5 and 6.1 mgs/dl and for females between 1.7 and 4.9 mgs/dl. Inorganic phosphorous values were found to be between 2.2 to 4.5 mgs/dl.

### Enzymes

Creatinine Kinase range of 29 - 141 IU/L was found to be significantly different in healthy subjects from other two groups as also serum amylase range 10 - 130 IU/L whereas all other enzymes studied showed no significant change from remaining two groups.

### Creatinine and Urea

The range of values for creatinine was found to be 0.45 to 1.1 mg/dl and for urea 9 to 38 mgs/dl.

### Plasma Electrolytes

The range of values for plasma electrolytes were found to be : Sodium 135 - 141 mmol/L; Potassium 3.6 - 4.6 mmol/L; Chloride 99 - 107 and Bicarbonate 21 - 31 mmol/L.

## DISCUSSION

Plasma glucose showed most significant difference in healthy subjects compared to general population range and reported values in literature. The fasting glucose levels (82 - 114 mgs/dl) in healthy subjects are higher in adult Bahraini subjects compared to reported literature values of 60 - 100 mgs/dl. This is an important finding. Detail work is required to establish factors responsible for higher fasting glucose levels, including genetic influence. This will have an important bearing on etiology of diabetes in local population. Influence of physiological factors like age, sex and food habits are also being studied.

Serum cholesterol in normal subjects showed lower values (95 - 235 mgs/dl) compared to the population range and reported values in literature (114 - 280). Similarly, for triglycerides the range in normal subjects is lower than other two group of values. This is probably due to selective age group (16 - 27 yrs) undertaken for the present study. The overall range for all age groups will be determined when other age groups are taken up for the study.

Both males and females show lower uric acid values compared to Salmaniya's values and reported values in literature. This is again explained in terms of restricted age group selected for the present study.

Inorganic phosphorous values are not significantly different from overall range of Salmaniya.

Except creatinine kinase and amylase all enzyme activities in normal subjects show no significant variations compared to other two group values. Creatinine kinase range of 29 - 141 IU/L is significantly different from other two groups of values which are 0 - 217 IU/L and 21 - 232 IU/L respectively. The probable reason

for this difference will be future subject of study. Serum amylase values in healthy subjects show wider range of values (10 - 130 IU/L) compared to Salmaniya (25 - 93 IU/L) and reported literature value (23 - 85 IU/L).

Creatinine and urea values in healthy subjects show no significant variations from reported normal range and overall population range. Except for the sodium which shows lower values at upper range, all other plasma electrolytes show no significant variations from the reported values in literature.

The present work establishes the reference values for the parameters studied in adult age group (16 - 27 years) of local population.

The work is being continued for other age groups. Detailed analysis of data will be carried out on completion of all age group studies and influence of various factors like age, sex, socio-economic background and genetics will be studied.

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**TABLE I**
**Case History Form**

*Name :* *Date of Birth :* *Sex :*
*Place of Birth :*

*Nationality :* *Parent's :* *Grand parent's :*

*Marital Status :* *Resident of Bahrain :*
Since Birth/Since last years.

*Socio-economic status :* Low/Middle/High

*Address :* *Telephone :* *Family Physician :*
*Tel. No. :*

*Body Weight :* *Body built :* Normal/Thin/Obese

*Profession :* *Nature of work :* Seden tary/Field/Travelling :
*Recent Illness :*

*Family History :* Any of the family members suffering from :
Diabetes/Heart diseases/Arthritis/Gout/High B.P./Any other.

HABITS : *Smoker :* Moderate/Heavy/Non. *Alcohol :* Occasional/Regular

*Drugs :* Do you take any of the followings regularly ?
Analgesics/Sedatives/Purgatives/Vitamins/Any other :

*Food :* High carbohydrate/High fat/High protein/Mix.

*Food Habits :* Regular/Irregular.

WATER : *Drinking :* Sweet/Hard. *Cooking :* Sweet/Hard.

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**For women only**

*Married at the age of :* *Age of the last child :* *No. of children :*

*Premenopausal/Postmenopausal*

*Use of oral contraceptives, if any.* *L.M.P.*

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**Earlier Investigations**

*Summary of earlier investigations :* Copy of reports, if available
OR from School/College/Employer/Clinic Records.

**TABLE II**

**Routine Chemistry**

| *Parameter* | *No. of samples* | *Normal subjects (mgs/dl)* | *Population Range (mgs/dl)* | *Literature (mgs/dl)* |
|---|---|---|---|---|
| Cholesterol | 405 | 95 — 235 | 116 — 296 | 114 — 280 |
| Triglycerides | 405 | 10 — 130 | 30 — 230 | 23 — 200 |
| Creatinine | 437 | 0.45 — 1.1 | 0.4 — 1.5 | 0.4 — 1.6 |
| *Uric Acid :* | | | | |
| Men | 198 | 2.5 — 6.1 | 3.7 — 7.4 | 3.5 — 7.9 |
| Women | 238 | 1.7 — 4.9 | 2.5 — 5.6 | 2.1 — 7.0 |
| Phosphorous | 400 | 2.2 — 4.5 | 1.8 — 5.5 | 2.0 — 4.9 |
| Magnesium | 400 | 1.6 — 2.2 | 1.5 — 2.7 | 1.8 — 2.4 |
| Glucose | 460 | 82 — 114 | 73 — 119 | 60 — 100 |
| Urea | 460 | 9 — 38 | 11 — 44 | 13 — 38 |

**TABLE III**

**Some Important Enzyme Activities of Diagnostic Values (IU/L)**

| *Parameters* | *No. of samples* | *Normal Subjects* | *Population Range* | *In Literature* |
|---|---|---|---|---|
| SGOT | 400 | 20 — 44 | 23 — 51 | 25 — 41 |
| SGPT | 400 | 1 — 25 | 1 — 34 | 3 — 36 |
| LDH | 400 | 131 — 235 | 127 — 239 | 100 — 190 |
| CK | 400 | 29 — 141 | 0 — 217 | 21 — 232 |
| Acid. Phos. | 400 | 0.36 — 0.76 | 0 — 0.71 | 0 — 0.8 |
| Alk. Phos. | 400 | 47 — 107 | 47 — 107 | 25 — 97 |
| Amylase | 400 | 10 — 130 | 25 — 93 | 23 — 85 |

**TABLE IV**
**Plasma Electrolytes in Bahraini Population (mmol/L)**

| *Parameters* | *No. of samples* | *Normal Subjects* | *Population Range* | *In Literature* |
|---|---|---|---|---|
| Sodium | 385 | 135 — 141 | 136 — 147 | 137 — 148 |
| Potassium | 385 | 3.6 — 4.6 | 3.5 — 5.0 | 3.9 — 5.0 |
| Chloride | 385 | 99 — 107 | 98 — 108 | 100 — 107 |
| Bicarbonate | 385 | 21 — 31 | 21 — 30 | 24 — 30 |

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