ORIGINAL ARTICLE

BIOCHEMICAL PROFILE AT GILGEL GIBE FIELD RESEARCH CENTER, SOUTHWEST ETHIOPIA

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ABSTRACT

BACKGROUND: The biochemical reference ranges currently used in developing countries are derived from data collected from populations living in developed countries. However, it is a fact that there is considerable variation in biochemical reference intervals by several variables. Moreover, reference ranges provided by different laboratory manuals and books do not also solve this problem. Biochemical profile at population level is scanty in the Ethiopian situation. Therefore, this study was conducted to determine the biochemical profiles for general population in community settings.

METHODS: A population-based cross-sectional study was conducted in Gilgel Gibe Field Research Center (GGFRC) from late September 2008 to end of January 2009. The study setting included both rural (majority) and urban dwellers. A total of 1,965 (955 men and 1010 women) individuals aged 15-64 years were included. Fasting blood glucose was determined immediately at field. Blood sample was collected by vacutainer tube without anticoagulant and transported to Jimma University Specialized Hospital laboratory for determination of total cholesterol, triglycerides, total serum protein, blood urea nitrogen, creatinine, uric acid, alanine aminotransferase and aspartate aminotransferase. Data were entered into EpiData and analyzed using SPSS for Windows version 16.0 and STATA 11.

RESULTS: The mean total cholesterol value for both sexes was 141.0 mg/dl with higher values for women at different age strata. The mean FBS level of the study population was 96 mg/dl. The mean values for blood urea nitrogen, creatinine and uric acid were 14.1 mg/dl, 0.86 mg/dl and 4.4 mg/dl. The mean level of alanine aminotransferase and aspartate aminotransferase of the study population were 27.2 U/L and 31.2 U/L, respectively.

CONCLUSION: All biochemical values in this study except for blood urea nitrogen were not different from values in other reports. Even though our finding showed similar ranges with reported values, there might be a variation in values across the country. Therefore, we recommend conducting similar nationally representative study to validate the current finding. .

KEYWORDS: Biochemical values, Cholesterol, Fasting Blood Glucose, Southwest Ethiopia

INTRODUCTION

Lack of appropriate local reference values for biochemical parameters are challenges in interpreting results for management of patients and other decision making. Health professionals usually use textbook reference values to compare the reported values. However, such values have substantial variability between subjects by age, sex, geographic, environment and genetic variation (1-6). As the clinical chemistry reference values are based on western population, they may not match with the African profile. Moreover, the laboratory method used to establish the reference

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values can lead to different results. Inappropriate reference values may increase the risk of either unnecessary additional investigations, failure to detect underlying disease or mismanagement of patients. Normality of values for a given individual are usually defined in terms of the range of results typically encountered from similar subjects who are known to be in good health. Reference values for clinical use should correctly represent a defined group of population which should have close similarity with the patients under investigation. A reference value may be defined as a value obtained by observation or measurement of a particular type of quantity on a reference individual (2, 3). Until now, no well documented reference value of biochemical profiles of Ethiopian Population is established.

Textbook reference values have been derived from a variety of samples (3, 5, 6). Limited studies are available from developing countries and scanty information is available for Africa. Studies from some parts of the United States of America and Africa showed differences in biomarkers profile (7-10). Some studies conducted in Asia and Africa showed lower values compared to the established Western references as presented elsewhere (9, 11).

The few studies conducted on African populations indicated differences in normal values compared with those from populations in developed countries (8-11). The report mentioned above from Ghana showed median alkaline phosphatase (AP), alanine amino-transferase (ALT) and aspartate amino-transferase (AST) to be 193.6, 24.3, and 31.3 U/L respectively among men. Findings for women were 171.8, 18.0, and 25.7 U/L, respectively. Median serum creatinine was 105.4 mmol/l among men and 91.0 mmol/l among women. Median blood urea nitrogen (BUN) value was 4.4mm/l and serum albumin 5.6 gm/dl (11). In a Kenyan community based survey, the median (95 percentile) total cholesterol was 3.8mm/L, Triglyceride 0.9mm/L (0.4-2.6) and fasting blood glucose 4.1mm/L (3.1-5.7) (10). These studies were conducted on certain segment of healthy workers and might not be representative of the normal population and thus lack generalizability justifying the need for a population-based study.
As described above the ethnic origin, genetics, gender, geography, and environmental factors, may influence some biochemical values

suggesting that the development of reference values for the Ethiopian population is imperative to improve quality of health care. Such valuable data at a local population level are scanty in the Ethiopian situation.

This study was therefore, conducted to determine the biochemical values for population in community settings. This can be used as reference values in the future evidence-based practices. Moreover, this study would serve as baseline information for further studies at national level.

SUBJECTS, MATERIALS AND METHODS

Population-based cross-sectional survey was conducted from late September 2008 to end of January 2009 at Gilgel Gibe Field Research Center (GGFRC) of Jimma University (JU). GGFRC is located around Gilgel Gibe Hydroelectric Dam, 55 kilometers Northeast of Jimma Town on the way to Addis Ababa. This study was part of the survey for determination of magnitude of chronic non-communicable diseases (CNCDs), risk factors of CNCDs and immunological and hematological value determination for the community at GGFRC.

Residents in the 10 kebeles of GGFRC with age range from 15 to 64 years of both sexes were included. The plan was to collect blood samples for biochemical values measurement from apparently healthy 60% (3,300) of the total sample for CNCDs survey as per the recommendation of WHO (12). Individuals were selected from the total sample by simple random sampling. The sampling procedure is presented schematically on page 5 this issue.

Formats for recoding measurement values were adapted from the WHO manual for the biochemical values (12).

Two laboratory technicians and two nurses were identified and trained on blood sample collection, immediate fasting blood glucose (FBG) determination, completing the recording format, labelling blood sample, storage and transportation of the sample to Jimma University Hospital laboratory. They were provided with manual that covers the standard operating procedures of blood sample collections and FBG determinations.
After completion of the interview, all respondents who were selected for biochemical tests were given instructions for overnight fasting (not to eat

or drink after 8:00 pm) and early morning appointment given. Whole blood sample was collected in the morning (8:00am to 12:00 noon) after cleaning the cubital area by 70% alcohol using vacutainer system and stored in vacutainer. FBG was determined immediately at field using glucometer (Sensocard, Hungary). The test tubes with blood samples were placed in ice-box and transported to the JUSH laboratory in the afternoon. Serum total cholesterol, triglycerides, total serum protein, blood urea nitrogen, creatnine, uric acid, alanine aminotrasnferase and aspartate aminotransferase were determined using Human star 80 (Gesellschaft fur Biochemica und Diagnostica, Germany) with specific reagents for each biochemical values as per the manufacturer's instructions. Six laboratory technicians trained on the purpose of the study, laboratory procedures and analysis, format completion and repository storage did the laboratory work within 12 hours of blood sample collection at Jimma University Specialized Hospital Laboratory.

Supervisors checked laboratory procedures randomly and each completed formats.

The leftover of collected blood from each individual was stored as serum repository in deep freezers at a temperature -80°C for future use.
Quality control

Jimma University Specialized Hospital Laboratory regularly participates in external quality assessment program which is being coordinated at national level by Ethiopian Health and Nutrition Research Institute (EHNRI) three to four times per year. During daily operation of the Human star 80 clinical chemistry analyzer, blood chemistry control with normal and high values were run before actual sample analysis according to the manufacture's instruction. Moreover, standard operating procedures were followed for all laboratory procedures.

Data was entered using EpiData and analyzed using SPSS for Windows version 16.0 and STATA 11. Background of study participants, biochemical summary values with measures of dispersion was determined when appropriate.

Ethical clearance was obtained from Jimma University's Research and Publication Office.

Signed informed consent was obtained from study participants before interview, physical measurements and blood sample collection.

Detailed information on methods is described under article one and four of this special issue.

RESULTS

This study presented distribution of some biochemical profiles of 1965 randomly selected individuals from a community setting. Background information of study participants is shown in article one of this special issue.

In general, the total mean cholesterol level at different age strata was higher for women than men. The mean (95% CI) total cholesterol value was 137.7 mg/dl (133.7-141.7) for men and 144.9 mg/dl (141.3-148.5) for women with the highest value for both sexes in those age 55 years and above. The total cholesterol level of 95% of the men was 52.1 to 252.2 mg/dl and that of women 58.0 to 286.4 mg/dl. Total serum triglyceride level was slightly higher for men [mean=117.6 mg/dl (95% CI: 113.3-121.8)] than women [mean=114.2mg/dl (95% CI: 110.4-117.9)]. The median and 95 percentile range of total serum protein was 7.4 mg/dl (4.0-11.4) mg/dl for men and 7.4 mg/dl (4.6-11.7) mg/dl for women. The mean (95% CI) FBG level of the study population was 96 mg/dl (94.8-97.0) with the highest mean value was recorded on women aged 55 years and above. The mean (95% CI) total serum protein value for men and women was 7.6 mg/dl (7.5-7.8) and 7.9 mg/dl (7.6-8.0), respectively. On the other hand, the median values (95% percentile range) for FBG were 95.0 mg/dl (66.0-133.0) and 95.0 mg/dl (68.0-129.0) mg/dl, respectively (Table 1).

The mean (95% CI) values for BUN, creatinine and uric acid were 14.3 mg/dl (13.7-14.9), 0.9 mg/dl (0.8-0.9) and 4.6 mg/dl (4.5-4.7) for men and 13.8 mg/dl (13.2-14.3), 0.9 mg/dl (0.7-1.0) and 4.1 mg/dl (4.0-4.2) for women, respectively (Table 2).

Table 1: Distribution mean value with 95% CI and median with 95 percentile range of serum lipids, FBG and total serum protein, GGFRC, Sept 2008-Jan 2009.

Age group	Sex	Total Cholesterol (mg/dl)		Triglycerides (mg/dl)		Total Serum Protein (mg/dl)		Fasting Blood Glucose (mg/dl)	
		Mean (95% CI)	Median (95 percentile range)	Mean (95% CI)]	Median (95 percentile range)	Mean (95% CI)	Median (95 percentile range)	Mean (95% CI)	Median (95 percentile range)
15-24	Men (n=136,133,134, 135)	115.1 (107.8-122.4)	112.5 (48.0-201.7)	107.1 (97.2-116.9)	99.0 (38.0-248.3)	7.4 (7.1-7.6)	7.3 (3.5-10.0)	93.3 (90.4-96.2)	93.0 (66.8-125.8)
	Women (n=140,139,139,132)	128.5 (119.0-138.0)	115.5 (62.2-290.5)	108.4 (98.4-118.4)	93.0 (33.0-281.0)	7.8 (7.2-8.4)	7.5 (4.6-21.9)	89.9 (86.8-93.0)	93.0 (59.7-117.7)
25-34	Men (n=163,158,160,157)	141.7 (126.8-156.5)	129.0 (61.0-362.1)	111.4 (102.6-120.1)	98.0 (41.9-261.4)	7.7 (7.4-8.0)	7.6 (4.5-12.0)	94.0 (90.8-97.1)	95.0 (63.0-133.0)
	Women (n=100,195,198,193)	144.3 (136.2-152.4)	135.5 (55.1-298.7)	100.5 (93.4-107.5)	90.0 (38.8-230.9)	7.5 (7.3-7.7)	7.3 (5.0-11.5)	92.0 (89.4-94.7)	93.0 (65.7-129.3)
35-44	Men (n=182,179,180,179)	137.0 (127.4-146.6)	128.0 (48.6-268.7)	125.0 (114.4-135.6)	107.0 (37.0-337.0)	7.5 (7.4-7.8)	7.2 (4.5-11.4)	95.2 (92.6-97.8)	95.0 (69.0-119.0)
	Women (n=182,179,175,179)	146.8 (138.3-155.3)	142.0 (53.6-281.9)	119.2 (110.8-127.5)	111.0 (43.5-242.5)	7.6 (7.3-7.9)	7.5 (4.5-11.5)	96.1 (92.7-99.6)	95.0 (68.0-129.0)
45-54	Men (n=173,169,171,161)	142.8 (134.2-151.3)	139.0 (59.7-277.3)	128.2 (115.2-141.1)	110.0 (44.8-300.8)	7.4 (7.1-7.6)	7.2 (4.5-12.0)	98.8 (95.8-101.8)	97.0 (73.0-136.0)
	Women (n=178,173,174157)	149.1 (139.7-158.5)	146.0 (51.5-324.6)	122.4 (112.4-132.3)	105.0 (51.8-336.5)	7.6 (7.3-7.9)	7.4 (4.3-12.1)	96.4 (93.5-99.3)	97.0 (71.8-124.2)
55+	Men (n=213,210,207,199)	146.9 (139.1-154.7)	144.0 (62.4-284.2)	116.5 (109.0-123.9)	107.0 (40.8-236.5)	7.7 (7.3-7.8)	7.4 (3.9-11.1)	96.9 (93.4-100.5)	99.0 (61.0-153.0)
	Women (n=188,183,184,168)	151.2(142.9-159.5)	145.5 (68.9-281.6)	122.8 (113.6-131.9)	107.0 (33.2-289.0)	7.4 (7.2-7.7)	7.4 (4.0-12.1)	100.1 (97.6-102.6)	99.0 (73.5-135.8)
Total	Men (n=867,849,852,831)	137.7 (133.7-141.7)	131.0 (52.1-252.2)	117.6 (113.3-121.8)	104.0 (41.3-275.8)	7.6 (7.5-7.8)	7.4 (4.0-11.4)	95.9 (94.8-97.0)	95.0 (66.0-133.0)
	Women (n=888,869,870,829)	144.9 (141.3-148.5)	138.0 (58.0-286.4)	114.2 (110.4-117.9)	101.0 (41.0-261.2)	7.9 (7.6-8.0)	7.4 (4.6-11.7)	95.8 (94.8-96.2)	95.0 (68.0-129.0)
Both sexes		141.0 (138.3-143.7)	134 (55 – 276)	115.4 (112.7-118.2)	102 (41 – 264)	7.7 (7.6-7.8)	7.4 (4.4 – 11.6)	95.9 (95.1-96.6)	95.0 (68.0 – 131.0)

Table 2: Distribution mean value with 95% CI and median with 95 percentile range of serum BUN, creatinine, uric acid,. GGFRC, Sept 2008-Jan 2009.

Age group	Sex	BUN (mg/dl)		Creatinine (mg/dl)		Uric acid (mg/dl)	
		Mean [95% CI]	Median (95 percentile range)	Mean [95% CI]	Median (95 percentile range)	Mean [95% CI]	Median (95 percentile range)
15-24	Men (n=136,136,127)	13.7 (12.5-14.9)	12.3 (4.6-27.2)	0.8 (0.7-0.9)	0.8 (0.3-1.9)	4.8 (4.6-5.0)	4.6 (3.0-8.9)
	Women (n=139,139, 126)	14.1 (12.2-16.0)	10.5 (3.9-48.5)	0.7 (0.7-0.8)	0.7 (0.3-1.3)	4.2 (4.0-4.5)	4.0 (2.0-7.2)
25-34	Men (n=162,162,154)	15.7 (14.1-17.4)	11.8 (4.5-40.2)	0.8 (0.8-0.87)	0.8 (0.5-1.3)	4.7 (4.5-5.0)	4.5 (2.5-8.0)
	Women (n=200,200,187)	13.8 (12.6-15.0)	11.2 (4.0-37.0)	0.8 (0.73-0.8)	0.8 (0.2-1.3)	4.4 (3.9-4.9)	4.0 (1.9-7.4)
35-44	Men (n=182,182, 168)	13.7 (12.4-15.0)	11.9 (4.0-32.8)	0.9 (0.7-1.1)	0.8 (0.4-1.4)	4.6 (4.4-4.9)	4.5 (2.4-7.7)
	Women (n=180, 181,167)	13.9 (12.6-15.2)	11.5 (5.3-37.3)	0.8 (0.7-0.8)	0.8 (0.4-1.3)	4.1 (3.8-4.3)	3.8 (2.0-7.4)
45-54	Men (n=172,173,160)	14.7 (13.4-16.1)	12.5 (4.5-33.5)	0.8 (0.7-0.8)	0.8 (0.3-1.4)	4.4 (4.2-4.6)	4.0 (2.0-7.9)
	Women (n=178, 178,157)	13.8 (12.5-15.1)	11.0 (4.5-38.3)	1.3 (0.5-2.1)	0.8 (0.3-1.4)	4.1 (3.8-4.3)	4.1 (2.0-8.3)
55+	Men (n=212,210, 189)	14.6 (13.4-15.7)	12.5 (5.2-38.0)	0.9 (0.8-1.0)	0.8 (0.3-1.5)	4.7 (4.3-5.3)	4.4 (2.3-8.1)
	Women (n=188, 186,165)	14.5 (13.3-15.6)	12.6 (4.9-32.6)	0.8 (0.7-0.8)	0.8 (0.3-1.3)	4.0 (3.8-4.2)	3.7 (1.9-7.0)
Total	Men (n=864, 862,798)	14.3 (13.7-14.9)	12.0 (4.6-34.5)	0.9 (0.8-0.9)	0.8 (0.3-1.4)	4.6 (4.5-4.7)	4.4 (2.5-7.9)
	Women (n=885, 883, 802)	13.8 (13.2-14.3)	11.5 (4.5-35.8)	0.9 (0.7-1.0)	0.8 (0.3-1.3)	4.1 (4.0-4.2)	3.9 (2.0-7.2)
Both sexes		14.1 (13.7-14.5)	12.0 (4.6 – 35.0)	0.86 (0.80-0.92)	0.77(0.32– 1.32)	4.4 (4.3-4.5)	4.0 (2.0 – 7.4)

BUN= blood urea nitrogen

Table 3: Distribution mean value with 95% CI and median with 95 percentile range of ALT, AST and alkaline phosphatase, GGFRC, Sept 2008-Jan 2009.

Age group	Sex	ALT (U/L)		AST (U/L)		Alkaline Phosphatase (U/L)	
		Mean [95% CI]	Median (95 percentile range)	Mean [95% CI]	Median (95 percentile range)	Mean [95% CI]	Median (95 percentile range)
15-24	Men (n=136,136,135)	29.3(27.4-31.1)	27.0 (14.4-60.7)	31.8(30.0-33.6)	30.0 (12.4-58.0)	227.9(202.2-253.6)	196.0 (21.2-656.4)
	Women (n=,139,137,137)	27.9(25.7-30.1)	25.0 (11.0-70.5)	31.9(29.4-34.4)	28.0 (11.0-72.7)	214.9(198.6-231.1)	199.0 (91.8-440.6)
25-34	Men (n=163,162,160)	29.9(27.8-32.0)	28.0 (13.0-56.9)	32.7(30.7-34.7)	31.0(14.1-61.90	173.0(164.7-181.3)	174.5 (25.7-309.6)
	Women (n=,200,198,198)	25.8(24.4-27.2)	26.0 (8.0-46.0)	30.5(28.8-32.2)	28.5 (10.0-58.0)	199.6(189.0-210.2)	189.5 (63.9-360.2)
35-44	Men (n=182,180,182)	28.1(26.6-29.7)	27.5 (10.6-51.9)	31.3(29.5-33.2)	29.0 (12.0-61.9)	181.2(172.1-190.4)	179.5 (82.5-351.3)
	Women (n=182,182,177)	26.3(24.8-27.8)	25.0 (12.0-54.0)	30.7(28.8-32.5)	29.0 (13.0-65.0)	186.9(175.1-198.7)	176.0(51.7-397.6)
45-54	Men (n=170,172,171)	28.1(26.2-30.1)	26.0 (10.0-58.0)	32.3(30.3-34.3)	31.0 (14.0-68.9)	174.0(162.1-185.9)	170.0 (51.1-311.5)
	Women (n=176,177,174)	26.6(24.8-28.5)	25.0 (10.0-57.0)	30.0(28.1-31.9)	28.0 (11.5-56.6)	198.0(186.7-209.4)	198.5 (75.8- 350.6)
55+	Men (n=213,213,210)	25.4(23.9-27.0)	24.0 (11.1-49.3)	29.6(27.8-31.3)	28.0 (11.4-57.4)	189.3(181.3-197.4)	180.5 (67.4-302.6)
	Women (n=188,185,184)	26.3(24.9-27.8)	26.0 (11.7-57.0)	30.4(28.7-32.2)	29.0 (14.0-63.4)	205.9(193.8-217.9)	203.5 (42.4-421.80
Total	Men (n=867,861,858)	27.9 (27.2-28.7)	26.0 (11.2-56.0)	31.0 (30.2-31.8)	29.0 (13.0-59.5)	187.4 (181.8-193.0)	179.0 (55.8-362.9)
	Women (n=885,879,870)	26.6 (25.9-27.3)	25.0 (10.1-54.0)	30.2 (29.4-31.0)	28.0 (12.0-59.9)	199.5 (194.4-204.6)	194.0 (70.4-384.4)
Both sexes		27.2 (26.7-27.7)	26 (11 – 54)	30.6 (30.0-31.1)	29 (12 – 59)	193.3 (189.6-197.0)	186 (63 – 376)

ALT= alanine amino transferase, AST =asparate amino transferase

The mean (95% CI) ALT and AST level of the study population were 27.9 U/L (27.2-28.7) and 31.0 U/L (30.2-31.8) for men and 26.6 (25.9-27.3) U/L and 30.2 U/L (29.4-31.0) for women, respectively. In most age strata, the mean ALT value was higher for men than women. The mean (95% CI) value of AP was 187.4 U/L (181.8-193.0) for men and 199.5 U/L (194.4-204.6) for women. Highest values of AP, 227.9 U/L for men and 214.9 U/L for women were observed in the age group of 15-24 years. The median value with 95% percentile range by age and sex strata is also presented (Table 3).

DISCUSSION

Biochemical reference values are essential for evidence based practice. Many studies all over the world showed variability of reference values. Very few studies showed biochemical profiles on Ethiopian population in community setting (13). To the best of the authors' knowledge, the present study is more comprehensive in terms of the quantity and type of biochemical markers included and the size of the population studied.

The biochemical values determined in this study were some of the: metabolic chemical values (Fasting blood Glucose, total cholesterol, triglycerides and total serum protein); renal function tests (BUN, Creatinine and uric acid) and enzymes (ALT, AST and AP).

The mean FBG in the study population was 95.9 mg/liter which is comparable with findings from other study (14). The mean distribution was almost similar for men (95.9mg/liter) and women (95.8mg/liter). Similarly, another study also found no sex difference; however, the latter study used median value and determined the level of non-fasting sugar (10). Distribution of FBG by age showed an increasing pattern which might be explained by the expected relative reduced insulin sensitivity with increasing age.

Mean cholesterol level for both sexes in this study was 141 mg/dl (3.7mmol/L). This finding is similar with the median value found in population based study conducted in Kenya (10) justifying that the two countries are on similar epidemiologic transition. The mean value in women 144.9 mg/dl (3.9mmol/L) is slightly higher than men137.7 mg/dl (3.6mmol/L) evidencing that women are fatty than men. The sex difference is similar with the finding in Kenya (10). In terms of age, in general, there is an increasing trend of mean cholesterol level.

In this study the mean values for Triglyceride, BUN, Creatinine, uric acid, ALT, AST and AP were similar to Kenyan study (10) except for BUN which was higher. The report from Ghana showed a median value (7.92 mg/dl) which was less by nearly half of the current finding (11). The higher mean and median ALT value for men in this study is in line with other reports (15, 16). Such differences could come from the variability between subjects by age, sex, geographic, environment and genetic variation (1-6) besides the design and sample effect.

Comparison of biochemical values of the current study findings with other studies from different parts of the world is presented in table 4.

In conclusion, this study has established baseline values for biochemical parameters in "apparently healthy" Ethiopians. All biochemical values except BUN were found to be similar with values reported from different countries. Even though our finding showed similar ranges with reported values, there might be a variation in values across the country. Therefore, we recommend conducting similar nationwide study to determine the biochemical reference values of the Ethiopian population as a whole.

Table 4: Biochemical values comparative table for showing the currents study findings, textbook references and some other countries, Sept 2008-Jan 2009.

| Profile | Country | | | |
	Current study[§]	Text book references[17]	Cameroon[✢18]	East and South Africa[§]
Men				
Creatinine	0.8-0.9mg/dl	<1.5mg/dl	118.5(55.8)	47-109μmol/L
BUN	13.7-14.9mg/dl	10-20mg/dl	-	-
Uric acid	4.5-4.7mg/dl	2.5-8mg/dl	-	-
Total cholesterol	133.7-141.7mg/dl	<200mg/dl	-	-
Triglyceride	113.3-121.8mg/dl	<160mg/dl	-	-
FBS	94.8-97.0mg/dl	75-115mg/dl	-	-
Total serum protein	7.5-7.8mg/dl	5.5-8.0g/dl	7.39(1.53)	-
ALT (SGPT)	27.2-28.7U/L	0-35U/L	11.9(6.1)	8-61 U/L
AST (SGOT)	30.2-31.8U/L	0-35U/L	19.7(7.6)	14-60 U/L
Alkaline Phosphatase	181.8-193.0U/L	30-120U/L	118.5(55.8)	48-164 U/L
Women				
Creatinine	0.7-1.0mg/dl	<1.5mg/dl	118.5(55.8)	47-109μmol/L
BUN	13.2-14.3mg/dl	10-20mg/dl	-	-
Uric acid	4.0-4.2mg/dl	1.5-6.0mg/dl	-	-
Total cholesterol	141.3-148.5mg/dl	<200mg/dl	-	-
Triglyceride	110.4-117.9mg/dl	<160mg/dl	-	-
FBS	94.8-96.2mg/dl	75-115mg/dl	-	-
Total serum protein	7.6-8.0mg/dl	5.5-8.0g/dl	7.39(1.53)	-
ALT (SGPT)	25.9-27.3U/L	0-35U/L	11.9(6.1)	8-61 U/L
AST (SGOT)	29.4-31.0U/L	0-35U/L	19.7(7.6)	14-60 U/L
Alk Phosph.	194.4-204.6U/L	30-120U/L	118.5(55.8)	48-164 U/L

[§]95% CI of the mean, [✢]mean(SD)

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