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Determination of Cholesterol Levels for Some Selected Bank Workers in the Greater Accra Region of Ghana.

H. Konadu Agyeman, J.Owusu-Banahene, B. Konadu Agyeman, E. O Darko, M. Abubakar, D. N. Adjei, P. Owusu-Manteaw, G. O. Asiedu, E. Amoatey and E. Akortia

Radiation Protection Institute, Ghana Atomic Energy Commission, P.O. Box LG 80, Legon Accra.

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ABSTRACT

Cholesterol is a component of cell membrane and a precursor for steroid hormones and bile acids synthesized by the body cells and absorbed with food. Cholesterol has been identified as one of the major factors that affect and sometimes destroy the normal functions of the heart blood vessel. This study determines the cholesterol level of some selected bank workers of Ghana Commercial Bank (GCB) at Accra New Town Municipality between the ages of thirty five – forty five years respectively. Out of the twenty five (25) samples assayed four males were found above the normal cholesterol range of 3.5 - 5.5 mmol/l, and six females were found above the normal cholesterol range. In all 10 were found above the normal range while 15 were found within the normal range (3.5 - 5.5 mmol/l). The result shows that 40% of the women had high level of cholesterol while 60% of the men had a high level of cholesterol. In all 60% of the bank workers had high cholesterol level as compared to the reference range while 40% of the bank workers had their cholesterol levels within the reference range. About 26.66% were found to be females who were obese whilst 40% were also obese males.

1. Introduction

Cholesterol is a component of cell membrane and a precursor for steroid hormones; also bile acids synthesized by the body cells and absorbed with food. Cholesterol is transported in plasma through lipoproteins normally complexes between lipids and apolipoproteins. There are four classes of lipoproteins; these are high density lipoprotein density (HDL), low-density lipoprotein (LDL), very low-density lipoprotein (VLDL) and chylomicrons [24]. While low density lipoprotein (LDL) is involved in the cholesterol transport to the peripheral cells, High-density lipoprotein (HDL) is responsible for the cholesterol uptake from the cells [11]. The dysregulation of cholesterol metabolism is inextricably correlated with cardiovascular health and for this reason low density lipoprotein cholesterol (LDL-C) and high density lipoprotein cholesterol (HDL-C) are routinely used as biomarkers of cardiovascular disease risk. The aim of this work was to use determine the various lipoprofiles of workers at Ghana Commercial bank in the New Town branch [19].

The heart is one of the essential organs of the human body and as such, it performs so many functions needed by the body in order for it to continue to exist. In spite of it versatile nature, certain diseased condition prevents the heart from preforming its normal functions hence this could lead to heart failure. Cardiovascular diseases have been identified as one of the commonest disease that affects humans and sometimes destroys the normal function of the heart and quite a number of cases are reported each year in Ghana of Africa and the world at large [5].

The diagrams in the above figures **Fig1** and **Fig2** demonstrates the formation of plaques in the human arteries which leads to atherosclerosis.

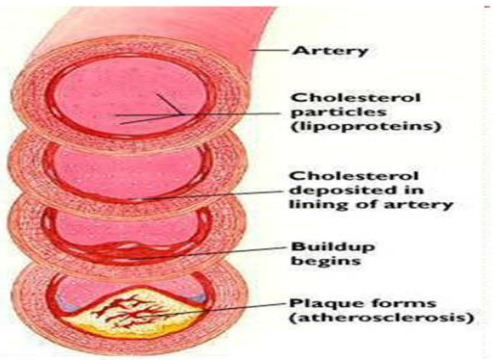

Fig 1. Formation of plaque in an artery.

Fig 2. Blockage in right artery leading to atherosclerosis.

Some foods contain nutrients which are required for healthy growth of the body. Fatty material constitutes about 25% of the dry weight of the cell. The presence of these fatty materials are known to enhance better growth and functioning of the living cells. However, they are also known to cause some serious problems when their levels are higher

Tele:
E-mail address: jewel5w@yahoo.com

than expected. One of such materials is cholesterol. Early in the 1930, the structure of cholesterol was determined and as shown in Fig 3 with the molecular formula of $C_{27}H_{46}O$ [22].

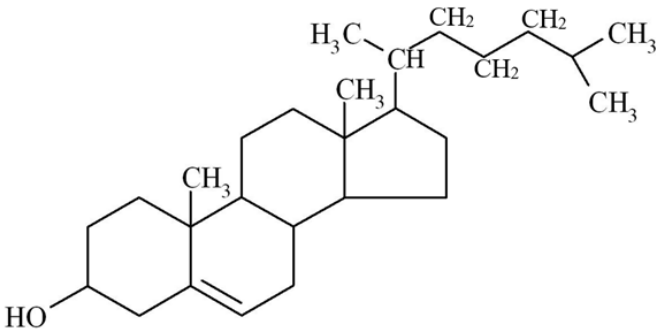

Fig 3: The molecular structure of Cholesterol.

The membranes of eukaryotic cells are usually rich in cholesterol than in prokaryotes [11].

Approximately 15% of cholesterol in our body is provided by diets and the remainder synthesized chiefly by the liver. This means that we do not need too much cholesterol in our bodies, since the liver can make adequate provisions for the body's needs when functioning properly [5].

There is strong evidence that consumption of palmatic acid, myristic acid and lauric acid raise the serum cholesterol. Another observation is that, over consumption of foods that contains highly saturated fatty acids raises the cholesterol levels [23]. The membranes of cholesterol above expected range could lead to lots of problems and complications. The commonest one being atherosclerosis and coronary artery disease which eventually lead to stroke and hypertension. The membranes of the individual Total Cholesterol (TC) level is used for screening purposes while for a better risk assessment, it is necessary to measure additionally high density lipoprotein and low density lipoprotein [5, 21].

2. Body Mass Index (BMI)

BMI is an important anthropometric index usually used for body fat status assessment and as an indicator for total body fat determination.

Workers' under study for this project could be classified into different BMI categories according to the World Health Organization (WHO) classification. This classification is in categories.

Category 1, acceptable (BMI < 25 kg/m^2); Category 2, overweight (BMI ≥ 25 but < 30kg/m^2); Category 3, obese (BMI ≥ 30 but < 40 kg/m^2); and Category 4, morbidly obese (BMI ≥ 40 kg/m^2).

2.1 Calculation of body mass index

The workers' data were collected for 25 adults over a wide range of diseases. The workers selected were all adults between the ages of 30 and 45 years with various types of heart diseases. Body weight was measured with light indoor clothing by an electronic balance with an accuracy of 0.1kg. Standing height without shoes was measured by a wall mounted stadiometer to the nearest 0.1cm. These measurements were taken while the workers' were relaxed, standing erect and had their arms at their sides and feet together. The calculation of the BMI was done, using the golden standard formula as shown in equation (1)

$$BMI = \frac{W}{H^2} \quad (1)$$

where W = weight of the workers in kilograms

H = height of the workers in meters

3.0 MATERIALS AND METHODS

3.1. Sample collection

About twenty five (25) bankers were examined and analyzed for their cholesterol concentration levels who were workers of the Ghana Commercial Bank at Accra New-Town branch. The blood samples of the bankers were taken in the morning and their lipid profiles were determined at the Trust Hospital. Each person was interviewed before blood samples of the bankers were taken in the morning and their cholesterol concentrations determined at the Trust Hospital also in Greater Accra of Ghana and put in a test tube.

3.2. Collection and Treatment of Blood Sample

All the 25 samples used for the assay were venous blood. A tourniquet was used to tie the upper part of the bend arm. A prominent vein was located on the arm and the area was disinfected with 70% of ethyl alcohol with the use of a string and needle, the prominently located vein was punctured and 5ml of blood sample was collected into a sterilized test tube. The blood sample was then rushed to the laboratory and allowed to clot at room temperature (25 ^{0}C). The serum was separated from the cells after spinning the blood samples at l000 rpm for 5 minutes with the help of a centrifuge [2] as shown in the fig 4.

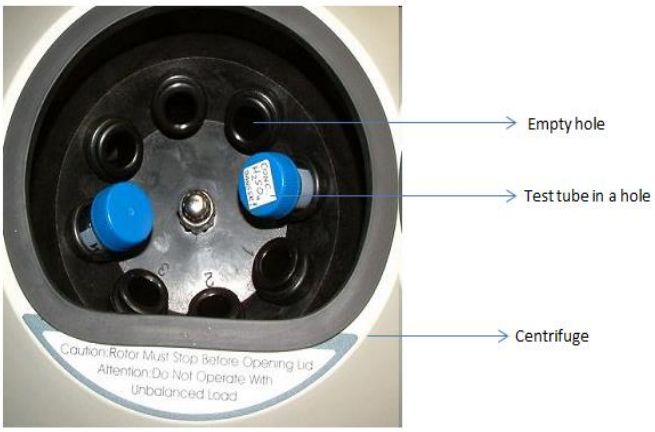

Fig 4. Separation of blood serum from blood cells using a centrifuge

3.3. Determination of Total Cholesterol

The method used was enzymatic-spectrophometric method (cholesterol oxidase/peroxidase method). The working reagents were brought to room temperature (25 ^{0}C) into the test tube labeled "B" which is the blank containing 100 µl of the working serum. Into another test tube labeled "ST" which means standard was introduced 1000 µl of the working reagent. The contents of each test tube was mixed thoroughly and incubated for 10 minutes at room temperature (25 ^{0}C). After incubation, the absorbance (A) of the standard and samples were measured at a wavelength of 500 nm with a colorimeter against the blank. The concentration of the serum cholesterol was measured using the formula below [2].

$$\frac{\boldsymbol{AS\ x\ standard\ concentration}(\frac{\boldsymbol{mg}}{\boldsymbol{dl}}\boldsymbol{cholesterol})}{\boldsymbol{AST}} \quad (2)$$

AS = Absorbance of the sample

AST = Absorbance of the standard

The unit of the value was converted to mmol/l by multiplying the values by 0.02586 where 0. 02586 is a constant for calculating of total cholesterol.

3.4. Principle

Cholesterol esters in the serum are hydrolyzed by the enzyme cholesterol esterase to free cholesterol and fatty acid. The free cholesterol is then oxidized by cholesterol oxidase to a

corresponding ketone called cholesterol -3- one and hydrogen peroxide. The hydrogen peroxide liberated is converted to water and oxygen by the enzyme peroxidase. The 4 - Aminoantipyrine takes up the oxygen produced and together forms a pink dye which can be measured at a wavelength of 515 nm. Free and esterified cholesterol in the sample originate by means of the coupled reactions described below [2].

3.5. Chemical Equations involved

Cholesterol ester + H_2O ……Cholesterol + fatty acid (3)

Cholesterol + O_2 …… Cholesterol + H_2O_2 (4)

$2H_2O$+4-Aminoantipyrine+Phenol…Quinoneimine+$4H_2O$ (5)

3.6. Determination of High Density Lipoprotein (HDL)

Pipette 250 µl of diagnostic reagent for quantitative in vitro precipitant of HDL for serum on photometric system. Introduce l00 µl of the serum, mix and incubate for l0 minutes at a room temperature of 25 ^{0}C. Centrifuge at l000 rpm for 5 minutes. Pipette l00 µl of the supernatant into l000 µl cholesterols diagnostic reagent. Then mix, incubate for l0 minutes at temperature of 20-25 ^{0}C or 5 minutes at 37 ^{0}C. Read absorbance at 490nmHg against blank total cholesterol diagnostic reagent [2].

3.7. Calculation of low density lipoprotein (LDL)

The relation below equation (4) shows how the LDL was calculated.

Low Density Lipoprotein=Total Cholesterol-High Density Lipoprotein-

(Triglycerides x $\frac{1}{2.2}$) (6)

3.8. Determination of Triglycerides

Centrifuge the retracted blood samples at l000 rpm for l0 minutes. Separate the serum from solid plasma with a Pasteur pipette. Prepare diagnostic in vitro determination of triglycerides in serum on photometric system by bringing it to 25 ^{0}C (room temperature). Pipette l000 µl of the reagent mixture into a clean test tube, introduce 10 µl of the serum into the reagent, then mix, incubate for 20 minutes at a temperature of 20-25 ^{0}C or 10 minutes at a temperature of 37 ^{0}C. Prepare a blank by introducing 10 µl of distilled water into 1000ul of mixed reagent. Mix, incubates for 20 minutes at 20-25 ^{0}C or 10 minutes at 37 ^{0}C. Read absorbance against blank within 60 minutes at a wavelength of 500 nm per Hg at an optical path length of 1 cm [2].

3.9. Principle

Triglyceride in the serum is hydrolyzed by lipoprotein lipase to Glycerol and fatty acid. The glycerol is then converted to Glycerol-3-Phosphate by an enzyme known as glycerokinase. The glycerol-3-Phosphate is then oxidized by glycerol phosphate oxidase to Dihydroxyaceton phosphate and hydrogen peroxide. The hydrogen peroxide combine with 4-aminoantipyrine together with 4-chlorophenol under the catalytic action of peroxidase to form quinoneimine [2] according to the chemical equations below from eqn(7) to eqn(10).

Triglyceride……Glycerol + Fatty acid (7)

Glycerol+ATP……Glycerol- 3- phosphate +ADP (8)

Glycerol-3-phosphate + O_2 ……Dihydroxyaceton phosphate + H_2O_2 (9)

$2H_2O_2$+Aminoantipyrine+4-hlorophenol……Quinoneimine + HCL +$4H_2O$ (10)

3.10. Selection and matching of cuvettes

Clean and dry several dozen cuvettes. Examine each cuvette and select those free from scrathes. Pipette l00 µl and add 1000 µl of cholesterol reagent mixed well and fill each cuvette with this solution.

Set the spectrophotometer at a wavelength of 515 nm in the band.

Set water blank on the transmittance scale.

3.11. Sources of error

The source of error may be those of the operator, method, equipment, or the sample.

3.11.1. Operator error

Human errors are common to all technical procedures. They can be reduced by adherence to oral and written instructions, familiarity with the equipment and with the sources of error, clinical importance of the test and good training.

3.11.2. Errors from the equipment

There may be a fault in an instrument which makes the calibration incorrect.

3.11.3. Calibration errors

An incorrect calibration may result, for example in an instrument reading higher or lower over its entire range.

3.11.4. Errors inherent from sample

Improper handling of cuvettes by the finger may leave finger stick errors which may affect the entire reading of the absorbance leading to high or low range.

.From **Table 1** below, it can be said that most of the selected bank workers do not exercise and this is likely to be one of the factors that has contributed to high serum cholesterol in them.

Table 1: Life style practices of some selected bank workers.

Life style activity	yes	Percentage response	no	Percentage response (%)	Total percentage
Smoking	7	28	18	72	100
Exercise	6	24	19	76	100
Stress	11	44	14	56	100
Alcohol Consumption	16	64	9	36	100

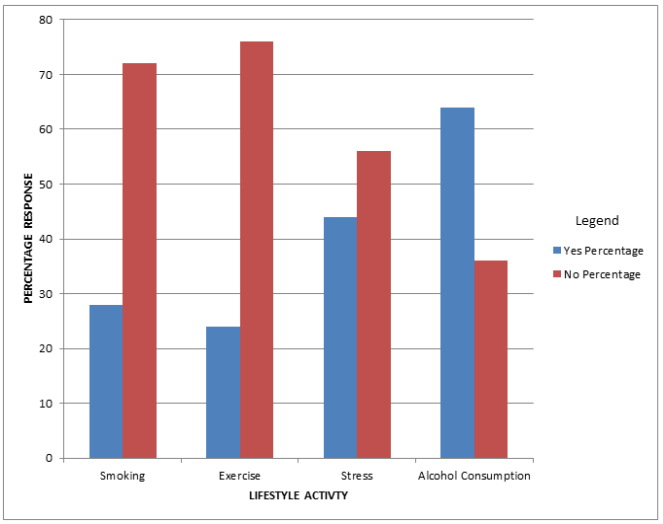

Fig 5. Variation of Percentage Response with Lifestyle Activities of bank workers' .

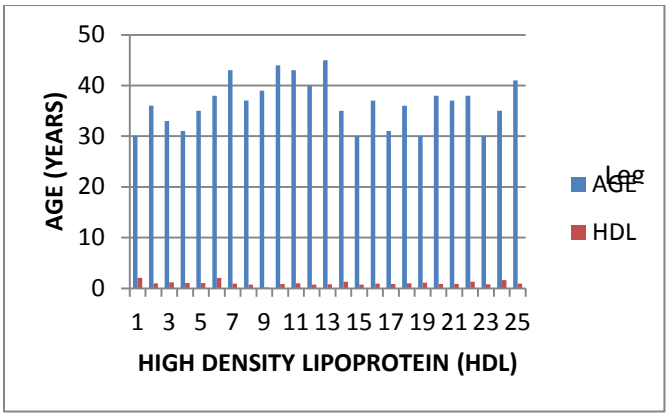

Fig 6. Variation of Age with high density lipoprotein (HDL) of bank workers'.

From Fig 5 and Fig 6 above all of them are said to be in their active age, thus 30- 45 years, this might therefore be a serious factor in determining their serum cholesterol level. However the variations in their cholesterol level may be due to their ability to exercise and intake of diet.

Most of the female workers had their serum cholesterol level between the normal range 3.2 - 5.2 mmol/1. Only six of them had theirs to be above the normal range. The questionnaires answered indicated that these six people ate fatty food and did not exercise their bodies.

In men, the serum cholesterol level seems to be varying irrespective of their weight. Most of them despite their weight are still engage in active physical activities while others do not; so serum cholesterol level in men is much dependent on their ability to exercise than their weight [21].

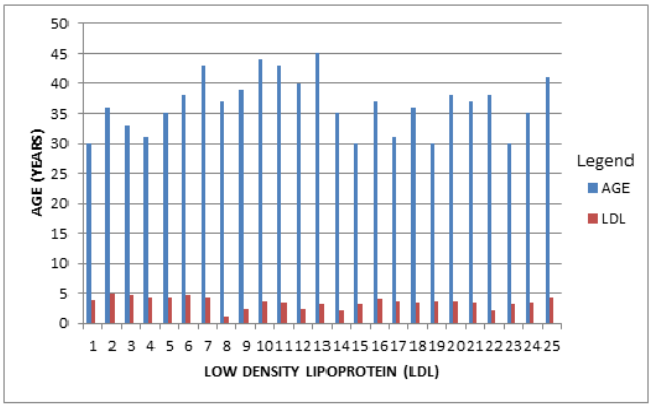

Fig 7: Variation of Age with Low Density Lipoprotein (LDL) of the bank workers'.

In the graph above, the trend of weight and cholesterol level in women seems to be positive in direction. Most of the women who are heavily weighted are at of increasing their serum cholesterol level since they cannot exercise and they are mostly unable to engage in physical activities.

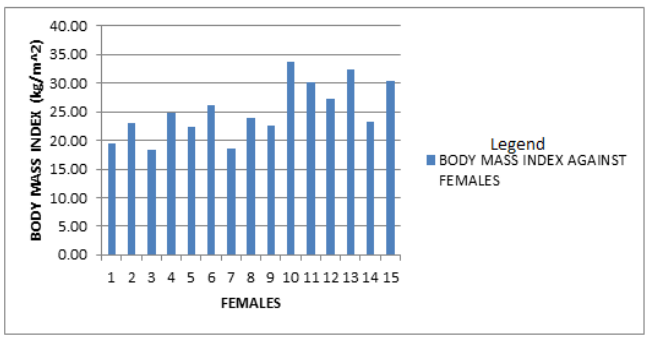

Fig 8: Body Mass Index against Females of the bank workers'.

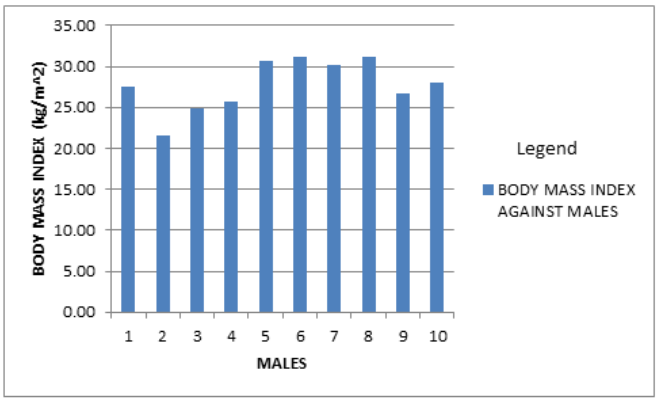

Fig 9: Body Mass Index against Males of the bank workers'.

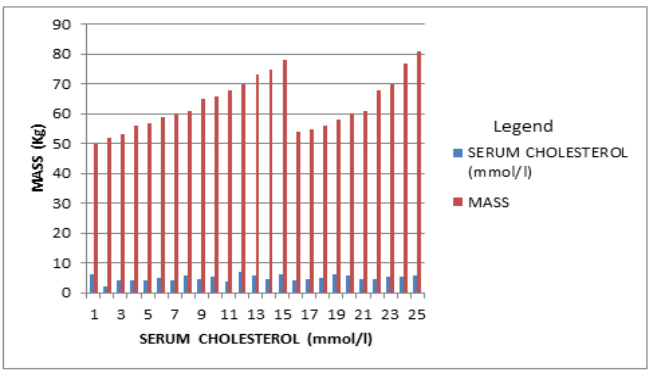

Fig 10: Variation of serum cholesterol with mass of the bank workers'.

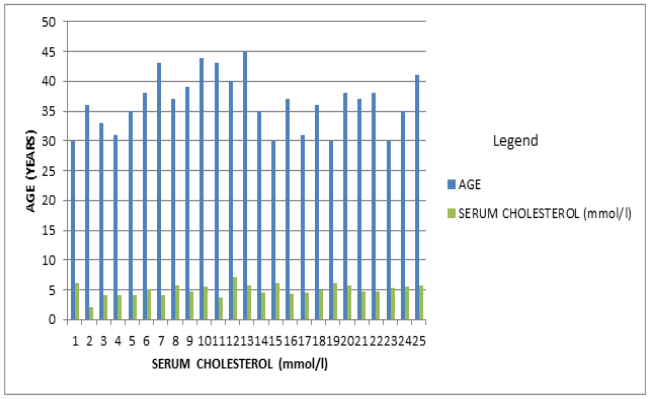

Fig 11: Variation of Age with Serum Cholesterol of the bank workers'.

4.0. DISCUSSION

The Ghana Commercial Bank workers at Accra New-Town branch of the Greater Accra; consist mostly of civil servants whose social standard may be classified as either belonging to the medium or high class. Usually, the cholesterol concentration of each individual depends on their ability to obtain diets rich in cholesterol such as fatty foods and dietary products and these sometimes depends on their social standard which was based on their income.

Chain smokers have elevated serum cholesterol level due to the effect of the chemicals in the smoke which affects the liver. Smoking causes the liver to synthesize high level of LDL fractions (Bad cholesterol) and low levels of HDL (Good cholesterol). It is also thought to be an important risk factor for heart diseases. Smoking also increases the tendency for blood to clot inside blood vessels. This obstructs blood to flow to vital organs such as the heart [8].

Out of the twenty five (25) adults, only seven (7) confirmed being occasional smokers. This will, therefore not have much effect on the cholesterol level.

The research in general is thought to have beneficial effect on cholesterol metabolism. This is because during research consumed fat which serves as major precursor is used to generate energy [1].

Six (6) out of the 25 people engage in physical exercising. This explains why 24% had low cholesterol level.

Obese people have a greater amount of saturated fat in their bodies and this raises blood cholesterol level. As a result, serum cholesterol also increases [22]. Those with body weight within the range of 60 to 81kg showed an increase in the level of cholesterol as compared to those below this range [4].

Out of the ten male workers whose bloods were tested six of them representing 24% had their serum blood cholesterol level to be more than the normal level. Out of the female workers whose bloods were tested eight of them representing 36% had their serum to be more than the normal level. In total out of the twenty five workers whose blood samples were tested fourteen of them representing 56% had their serum cholesterol level to be normal.

5.0. CONCLUSION

The results show that 24% of the male workers and 36% of the female workers had their cholesterol levels above the normal range 3.5 -5.2 mmol/l. In all 56% of the bank workers had high cholesterol level as compared to the reference range while 24% of the bank workers had their cholesterol level within the reference range. From the results it can be concluded that most of the bank workers were at risk of having high serum total cholesterol levels due to their inability to exercise and intake of fatty diets.

Serum cholesterol level is mostly dependent on the diet, exercising and sometimes age and therefore the bank workers the Bank workers whose job description requires a lot of sitting should set aside some time to exercise regularly to control their cholesterol levels.

Secondly it would also be essential that they control the intake of cholesterol through their diet and hence take in low saturated fat.

Further research should be done to determine meaningful ways by which most workers whose job description require a lot of sitting can control their serum cholesterol level. Also cholesterol medication (drugs) should always be taken by the workers involved.

6.0 ACKNOWLEDGEMENT

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APPENDIX

Sample Number	Sex	Age (yrs)	Serum Cholesterol (mmol/L)	HDL (mmol/L)	LDL (mmol/L)	Mass (Kg)	Height(m)	BMI (Kg/m^2)
1	F	30	6.20	2.05	3.95	50	1.6	19.53
2	F	36	2.10	0.99	4.98	52	1.5	23.11
3	F	33	4.20	1.2	4.84	53	1.7	18.34
4	F	31	4.20	1.06	4.28	56	1.5	24.89
5	F	35	4.20	1.06	4.31	57	1.6	22.27
6	F	38	5.10	2.05	4.71	59	1.5	26.22
7	F	43	4.20	0.92	4.37	60	1.8	18.52
8	F	37	5.70	0.71	1.17	61	1.6	23.83
9	F	39	4.70	0.13	2.39	65	1.7	22.49
10	F	44	5.50	0.85	3.66	66	1.4	33.67
11	F	43	3.80	0.99	3.55	68	1.5	30.22
12	F	40	7.20	0.71	2.5	70	1.6	27.34
13	F	45	5.70	0.81	3.24	73	1.5	32.44
14	F	35	4.50	1.28	2.24	75	1.8	23.15
15	F	30	6.20	0.71	3.35	78	1.6	30.47
16	M	37	4.40	0.92	4.02	54	1.4	27.55
17	M	31	4.60	0.85	3.71	55	1.6	21.48
18	M	36	4.90	0.99	3.47	56	1.5	24.89
19	M	30	6.10	1.13	3.58	58	1.5	25.78
20	M	38	5.80	0.85	3.66	60	1.4	30.61
21	M	37	4.80	0.85	3.55	61	1.4	31.12
22	M	38	4.70	1.28	2.24	68	1.5	30.22
23	M	30	5.30	0.82	3.23	70	1.5	31.11
24	M	35	5.50	1.64	3.52	77	1.7	26.64
25	M	41	5.70	0.92	4.23	81	1.7	28.03