Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2014; 2(4E):1477-1483 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com **DOI:** 10.36347/sjams.2014.v02i04.069

Research Article

Reference Values of Lipid Profile for Population of Haryana Region

Yuthika Agrawal[1], Vipin Goyal[2*], Kiran Chugh[3], Vijay Shanker[1]
[1]Department of Biochemistry, SHKM Medical College, Nalhar, Mewat, Haryana, India
[2]Department of Chest and TB, SHKM Medical College, Nalhar, Mewat, Haryana, India
[3]Department of Biochemistry, PGIMS, Rohtak, Haryana India

***Corresponding author**
Dr. Vipin Goyal
Email: drgoyal912@yahoo.co.in

Abstract: According to IFCC, it is necessary for every laboratory to have its own set of reference limits. Several factors are known to influence the clinical laboratory parameters. Relationship of lipids and other risk factors with cardiovascular and cerebrovascular events has been clearly established. The objective of this study was to analyze the baseline levels of blood lipids in apparently healthy population in the locality of a premier tertiary hospital in Haryana in an attempt to set up reference values for total cholesterol, triglycerides, HDL- cholesterol, LDL and VLDL in the population and to compare these with the internationally recommended ranges. A reference interval for each parameter was calculated from the 95% reference intervals ranging from 2.5% and 97.5% percentiles and, arithmetic mean $\pm$ 2 SD were also calculated. The 95% reference range for triglyceride was 61-156 mg/dl, for serum cholesterol was 85-211mg/dl, for HDL was 20-63mg/dl, for LDL was 50-147mg/dl and for VLDL was 12-31 mg/dl for Haryana population. Clinicians of Haryana should take into consideration reference lipid values of this study for clinical evaluation.
Keywords: Reference value, lipid profile, triglyceride, cholesterol, HDL, LDL

INTRODUCTION

The concept of reference intervals was introduced by International federation of clinical chemistry (IFCC) to avoid the problems with normal values and values obtained from an individual under clinical investigation. An important part of medical decision in diagnosis is dependent on comparison of patient related observations with reference values. A reference value may be defined as a value obtained by observation or measurement of a particular type of quantity on a reference individual [1]. Laboratories should report test results along with reference intervals, typically called normal ranges [2]. Proper interpretation of results is based on the use of reference ranges established from healthy individuals [3]. IFCC recommends that every laboratory should establish their own set of reference limits [2] as health of an individual is not same in different countries, in the same country in different regions, at different time and in same individual at different ages, and is influenced by several factors like gender, age, race, ethnicity, environment, sample type, pre analytical variables, analytical procedures, instruments and geographical location of the healthy individuals [3].

Ischemic heart disease and cerebrovascular disease are the leading causes of mortality and morbidity throughout the world [4, 5]. Incidence of coronary artery disease increases with advancing age in men beyond 40 years and in postmenopausal women. Recently, the prevalence of these disorders is also reported in younger individuals [6, 7]. Relationship of lipids and other risk factors with cardiovascular and cerebrovascular events are established [8-10]. The role of lipoproteins for predicting coronary artery as well as cerebrovascular diseases is not fully understood [11,12].

During past two decades, expert panels from western and eastern countries [13-16] including National Cholesterol Education Programme (NCEP) of U.S [17-21] have released guidelines for preventing mortality from coronary artery disease. Expert committee has defined the appropriate medical decision cut off points for serum total cholesterol, high density lipoprotein-cholesterol (HDL), low density lipoprotein-cholesterol (LDL) and triglycerides for their population. This NCEP ATP III criterion has been shown in table 1. In India, most of the laboratory and clinicians use the reference intervals established in western population that usually does not match with Indian population especially in case of lipid profile [3], as serum lipids levels are much dependent upon genetic background, ethnicity and dietary pattern of a particular population [17] and although health professionals understand the importance of reference intervals many laboratories still do not have comprehensive data, especially ranges that

are specific for their typical patient populations. Therefore, clinical laboratories should establish reference ranges for serum lipids based on local healthy population [23].

Table 1: International Classification of Lipid as recommended by WHO and NCEP in (mg/dl) [20,22]

Classification	Cholesterol	HDL	Triglyceride	LDL
Desirable	<200	>60	<150	<130
Borderline	200-239	35-59	200-399	130-159
High	>240	-	>399	>160
Low	-	<35	-	-

Individual laboratories should pool data of minimum 120 samples in generating reference values for both as a theoretical concept and as a practical approach [24].

Thus the objective of this study was to analyze the baseline levels of blood lipids in 120 apparently healthy population in the locality of a premier tertiary hospital in Haryana in an attempt to set up reference values for total cholesterol, triglycerides, HDL- cholesterol, LDL and VLDL in the particular population and to compare these with the internationally recommended ranges.

MATERIALS AND METHODS

A total of 120 apparently healthy individuals coming to a tertiary govt. hospital in Haryana for regular health check up were included in this study. We have excluded individuals having diabetes mellitus, excessive body weight, dyslipidemias, smoking, hypertension, alcohol abuse, cardiovascular diseases, coronary bypass graft, any other chronic disease, recent surgery, diseases causing alterations in lipids, hypothyroid, hyperthyroid, drugs affecting lipid concentrations, strenuous exercise, renal diseases, hormone therapy, women on oral contraceptive and medication [25]. We analyzed lipid profile of these apparently healthy individuals from 12 hour overnight fasting serum sample. Serum total cholesterol was measured by enzymatic cholesterol esterase, peroxidase method, HDL by precipitation method and triglyceride by glycerol phosphate oxidase-PAP method from commercially manufactured reagent kits by fully automated chemistry analyzer. Very low density lipoprotein (VLDL) and LDL were calculated using Friedewald's formula [26]. For the purpose of analysis, mean, standard deviation, percentiles were calculated using SPSS software for windows version.

RESULTS

Out of total 120 individuals, were 60 females and 60 were males. The age of reference individuals ranged from 30-85years. Average age was 55.46±1.30 yrs. We have calculated mean and Standard deviation for cholesterol, triglyceride, HDL, LDL and VLDL which are tabulated in table 2. A reference interval for each parameter was calculated from the 95% reference intervals ranging from 2.5% and 97.5% percentiles and, arithmetic mean + 2 SD were also calculated. The results are shown in table 2, and distribution shown in figure 1 for respective parameters.

Table 2: Distribution of Lipid profiles among individuals

		Triglyceride	Cholesterol	HDL	LDL	VLDL
Number		120	120	120	120	120
Mean		102.93	162.85	43.45	98.67	20.78
Std. Error of Mean		2.555	2.802	.982	2.516	.508
Median		97.00	167.00	43.00	97.00	19.00
Std. Deviation		27.984	30.699	10.759	27.567	5.563
Range		102	144	46	112	20
Minimum		56	76	19	41	12
Maximum		158	220	65	153	32
Percentiles	2.5	61.10	85.40	20.08	50.00	12.03
	97.5	156.00	211.98	62.98	147.00	31.00

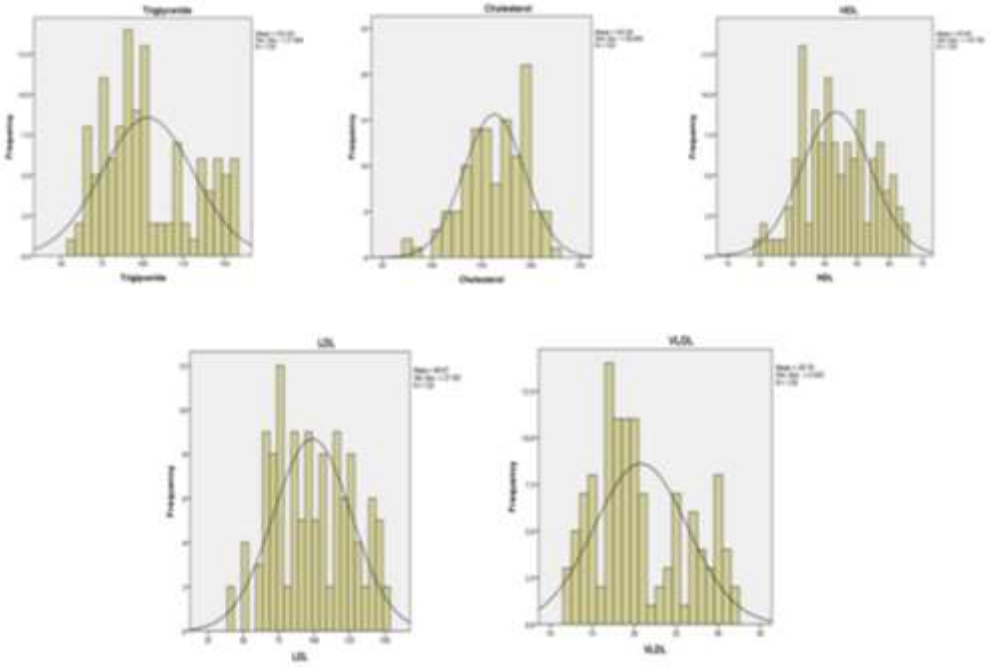

Fig. 1: Frequency distribution (Histogram) of Lipids in healthy Haryana population

Reference values should be based on percentiles determined from well-defined population samples. So 95% reference range for triglyceride was 61-156 mg/dl, for serum cholesterol was 85-211mg/dl, for HDL was 20-63mg/dl, for LDL was 50-147mg/dl and for VLDL was 12-31 mg/dl for Haryana population.

DISCUSSION

Being a very appropriate drug targets, the total cholesterol, LDL, HDL, and triglycerides are monitored routinely in almost all diagnostic laboratories for both the risk assessment and as follow-up investigations subsequent to administration of various statins. Generally it has been seen that most of the laboratories use literature data on manufacturers insert sheets [27] or reference range published by NCEP [20] as their reference range. The major reason behind this is that it is not feasible for most laboratories to collect enough samples from a sufficiently large reference, completely healthy individuals as recommended by authorities like IFCC, NCEP [28,29], and also the procedure is time consuming. Serum lipid profile is influenced by many factors like dietary habits of people, lifestyle and heredity factors like ethnicity, race along with the other factors as we have mentioned earlier like age, sex etc. In the present study we have established reference ranges for fasting lipid profiles for apparently healthy population of Haryana which have not been ever studied in this region.

The 95% reference range for serum triglyceride is 61-156 mg/dl, for serum cholesterol was 85-211mg/dl, for HDL was 20-63mg/dl, for LDL was 50-147mg/dl and for VLDL was 12-31 mg/dl for Haryana population. In the current study upper limit of the reference range of the lipid profile are higher than manufacturer's reference values. The upper limit of reference range for total cholesterol (212 mg/dl), triglycerides (156 mg/dl), LDL (147 mg/dl) in the studied population is greater than the manufacturer's reference range upper limit of 200 mg/dl, 150 mg/dl and 130 mg/dl respectively, while the lower limit of HDL is 20 mg/dl as compared to 40 mg/dl as recommended otherwise. These differences can be explained by fact that the observed slightly wider range of lipid profile of our study than the recommended reference range was probably mainly due to the sedentary lifestyle of people along with modern habit of junk food and lack of exercise mainly in urban area, where this tertiary institute is located. Due to urbanization and ethnic diversity, population of Haryana is mixed regarding food composition and dietary habits. The traditional diet of Haryana state is rich in milk proteins (milk, ghee, butter), contributing to the higher levels in the lipid profile. So, we can conclude that lipid profile pattern of Haryana population will be obviously different from that of western population. Though numerous reports are available in literature relating to serum/plasma lipids as important risk assessment parameters for atherosclerosis and similar kinds of studies were carried out in Punjab by Vaneet kaur *et al*. [30], in Assam by Madhumita Das *et al*. [31], in Maharashtra by Durgawale P *et al*. [32], in Ahemdabad (Gujrat) by Patel *et al*. [33], Andhra Pradesh by Malathi *et al*. [34], but due to the large variability of the lipid profile, as it is influenced by biological entities of a population, the comparison between data is not possible in real terms. Then too we have made an attempt to compare our results with other studies. While comparing with Jhala *et al*. [35], total cholesterol and LDL levels were found to be higher in the present study, whereas VLDL and TG levels were low. Compared to Goswami *et al*. [36]

study, the mean values of total cholesterol, HDL and LDL were low in the present study, whereas triglyceride and VLDL were similar. High HDL in Bengali population may be attributed to consumption of fish rich in omega 3 fatty acids which increases HDL level in the blood. The study population of Assam in Madhumita Compared to Goswami *et al*. [36] study, the mean values of total cholesterol, HDL and LDL were low in the present study, whereas triglyceride and VLDL were similar. High HDL in Bengali population may be attributed to consumption of fish rich in omega 3 fatty acids which increases HDL level in the blood. Study of Das M [31] was more consistent and comparable to the present study. The reference interval for total cholesterol was broader in our population as compared to Assamese population, and hence in Haryana population LDL and HDL were found to be higher. When study by T Malati *et al*. [34] study was compared with ours, no significant differences were found in the mean and reference intervals of TC, HDL and LDL in our study. The TG and VLDL values were significantly higher in Andhra Pradesh study [34]. Similarly, comparison of results of our study with earlier reports from city of Bombay (western part of India) [32] on 1070 healthy Indians have revealed similarities in total cholesterol, HDL and LDL concentration while in contrast to Malati *et al*., striking variations in triglycerides and VLDL concentration, as mean values of TG and VLDL in their study were 88.36 ±31.15 mg% and 18.11±7.35 mg% respectively which are lower as compared to our study, this can be due to, Haryana populations in contrast to western Maharashtra population consume more ghee. A study, conducted on ten big industrial populations across India on a total of 19973 subjects (20-60 yrs), established a surveillance network for CVD risk factor in an industrial setting, and reported mean total cholesterol and HDL comparable to our study, while triglycerides levels higher than that of our study (102.93 mg/dl). Though their study selected mixed population in which 40.2% of men, 34.4% of women had dyslipidemia, 28.6% of men, 18.2% of women had hypertriglyceridemia [37].

The observations from the present study and other published reports from India [37,38], China [39,40], Japan [41] and US [42] revealed highest total cholesterol in American of all races (>200mg/dl) followed by China, Japan and India. Indians including those of Haryana (163.85 mg/dl) seem to have relatively lower average cholesterol compared to other populations. Haryana population seems to also have relatively lower triglycerides compared to study reported from Americans, Europeans, Japanese and Chinese populations. Levels of total cholesterol, LDL and triglycerides were significantly lower in the present study as compared to 3044 elderly Japanese- American men [43]. Our study had significantly lower values than Concepcion *et al*. [44] study except for HDL [43, 44], the significant difference between these populations groups could be due to the environment, temperature difference and different dietary habits. In comparison to Haryana population, the people from these other races possibly consume more of animal fats and eggs [45]. The high HDL levels in the above foreign studies were in harmony with results obtained in the longevity syndromes [46], in which high values for HDL are a frequent finding. Contrastingly, as compared to the current study, the total cholesterol, LDL and HDL upper reference limits were higher in the current study, whereas the triglyceride reference intervals were comparable in Rustad P *et al*. [47].

Several manufacturers of laboratory reagents use arithmetic mean of lipid profile parameters to determine reference value. The mean + S.D., and taking mean + 2S.D. as reference range, the values of lipid profile parameters in our study was as follows: total cholesterol 162.85 + 30.70 mg/dl (reference range 101 - 224 mg/dl), triglycerides 102.93 + 27.98 mg/dl (reference range 47 – 159 mg/dl), HDL 43.45 + 10.76 mg/dl (reference range 22 – 65 mg/dl), LDL 98.67 + 27.57 mg/dl (reference range 43 – 154 mg/dl). Due to the presence of evident difference in the above data and reference provided by the manufacturers, we urge that clinical laboratories should determine their own reference values, taking into account the eating habits, genetics, lifestyle, environmental and inherent characters of population of their region. Also, the diversity of commercial test kits (even using the same analysis technique) in addition to the various sample selection methods, generates large numbers of variation in reference intervals that prevent proper comparison of results. Therefore the standardization and consensus in the evaluation is an important premise that should be followed in further studies.

Interestingly, the reports from same populations documented striking changes in lipid parameters over different time periods of study [42, 48-50]. Another study on 580 healthy volunteers revealed marked variation of lipids intervals among populations from six cities [51]. The variations in lipids concentrations were also observed with respect to rural and urban population residing in same country [50, 52]. Therefore, we recommend further research both regionally and nationally, for the determination of lipid profile cutoff points and comparison thereof with the upper limit of the reference intervals in different populations in India and internationally. These reference intervals for all lipid and lipoprotein parameters will immensely help in assessing associated risk for cardiovascular and cerebrovascular diseases in India. Additionally, our results may be beneficial in future in formulating medical decision limits for serum lipids pertaining to specific region in Indian population. Traditionally, NCEP in US involved about forty partners from private and public sectors and combined both public health and clinical/a high risk approach. The public health approach promoted life style modification habits leading to healthy heart whereas clinical risk approach

was reflected in formulating Adult Treatment Panel I, II & III guidelines for cholesterol management. ATP III recommended assessment of the prospective ten year risk for CHD in patients with 2 or more risk factors e.g. cigarette smoking, hypertension, low HDL cholesterol, diabetes, advancing age or family history of premature CHD. Finally the NCEP experts highlighted 1) Appropriate medical decision cut off limits for all lipid analytes in individuals with and without associated risk factors. 2) Future risk assessment and 3) importance of various life style modifications. Our study is just a step towards it.

Despite the reported values, the rigorous process of selection of healthy patients hinders proper comparison with other standard reference range. In the present study some characteristics of the region and study cohort like eating habits, physical activity were not considered, which could influence the alteration of plasma lipid concentrations. This can be considered as the limitation of our study.

CONCLUSION

There is a great need for reference ranges of other parameters like apolipoproteins, not included in this study to be established. The finding of this study opens an avenue for similar studies to be carried out in other geographical regions for various other parameters. It can be suggested that lipid values obtained in this study can be used as the reference value, based on which clinical correlation can be made. Clinicians of Haryana should take into consideration reference lipid values of this study for clinical evaluation.

REFERENCES

1. Burtis CA, Ashwood ER; Establishment and use of Reference Values. Tietz Textbook of Clinical Chemistry. Chapter 14, 3rd edition, W. B. Saunders Company, Philadelphia, U.S.A.,1991; 336-356.
2. Solberg H; International federation of clinical chemistry, expert panel on theory of reference values: approved recommendation on the theory of reference values. Part 1—The concepts of reference values. J Clin Chem Clin Biochem., 1987; 25(337–42): 639–644.
3. Glick MR, Ryder KW, Jackson SA; Graphical comparisons of interferences in clinical chemistry instrumentation. Clin Chem., 1986; 32: 470-474.
4. O'Flaherty, Ford E, Allender S, Scarborough P, Capewell S; Coronary heart disease trends in England and Wales from 1984 to 2004: concealed leveling of mortality rates among young adults. Heart, 2008; 94: 178-181.
5. British Heart Foundation; Coronary heart disease statistics. London: British Heart Foundation, 2007.
6. Stamler J, Daviglus ML, Garside DB, Dyer AR, Greenland P, Neaton JA; Relationship of baseline serum cholesterol levels in three large cohorts of younger men to coronary, cardiovascular and all cause mortality and to longevity. JAMA, 2000; 284: 311-318.
7. Strong JP, Malcom GT, Mc Mahan CA, Tracy RE, Newman WP III, Hedrick EE *et al*.; Prevalence and extent of atherosclerosis in adolescents and young adults' implications for prevention from pathobiological determinants of atherosclerosis in youth study. JAMA, 1999; 281: 727-735.
8. Ingelsson E, Schaefer EJ, Contois JH, McNamara JR, Sullivan L, Keyes MJ *et al*.; Lipid measures for prediction of coronary heart disease in men and women. JAMA, 2007; 298: 776-785.
9. Chien KL, Hsu HC, Su TC, Sung FC, Chen MF, Lee YT; Lipoprotein (a) and Cardiovascular Disease in Ethnic Chinese: The Chin-Shan Community Cardiovascular Cohort Study. Clin Chem., 2008; 54: 285-291.
10. Hippisley-Cox J, Coupland C, Vinogradova Y, Robson J, Minhas R, Sheikh A *et al*.; Predicting Cardiovascular risk in England and Wales: prospective derivation and validation of QRISK2. Brit Med J., 2008; 336:1475-1482.
11. Bennet AM, Angelantonio ED, Ye Z, Wensley F, Dahlin A, Ahlbom A *et al*.; Association of apolipoprotein E genotypes with lipid levels and coronary risk. JAMA, 2007; 298: 1300-1311.
12. Suzuki M, Wada H, Maeda S, Saito K, Minatoguchi S, Saito K *et al*.; Increased plasma lipid-poor apolipoprotein A-I in patients with coronary artery disease. Clin Chem., 2005; 51: 132-137.
13. Frohlich J, Fodor G, McPherson R, Genest J, Langner N; Dyslipidemia working group of health Canada. Rationale for and outline of the recommendations of the working group on hypercholesterolemia and other dyslipidemias. Interim report. Can J Cardiol., 1998; 14(suppl): 17A-21A.
14. Hata Y, Mabuchi H, Saito Y, Itakura H, Egusa G, Ito H *et al*.; Report of the Japan Atherosclerosis Society (JAS) Guideline for diagnosis and treatment of hyperlipidemia in Japanese adults. J Atherosclerosis and Thrombosis, 1998; 9: 1-27.
15. O'Connor PJ; Public health research, practice and policy cent. Preventing Chronic Diseases. CDC document 2005; 2: 3-13.
16. Prevention of coronary heart disease: Scientific background and new clinical guidelines Recommendations of the European Atherosclerosis Society prepared by the International Task Fore for Prevention of Coronary Heart disease. Nutr Metab Cardiovas Dis., 1992; 2: 113-156.

17. Bachorik PS, Ross JW; The National Cholesterol Education Program Working Group on lipoprotein measurement. National Cholesterol Education Program recommendations for measurement of low-density lipoprotein cholesterol: executive summary. Clin Chem., 1995; 41: 1414-1420.
18. Warnick RG, Wood PD; The National Cholesterol Education Program Working Group on Lipoprotein Measurement. National cholesterol Education Program recommendations for measurement of High density lipoprotein cholesterol: executive summary. Clin Chem., 1995; 41: 1427-1433.
19. Stein EA, Myers GL; The National Cholesterol Education Program Working Group on Lipoprotein Measurement. National Cholesterol Education Program recommendations for Triglycerides measurement: executive summary. Clin Chem., 1995; 41: 1421-1426.
20. National cholesterol education program expert panel on detection, evaluation and treatment of high blood cholesterol in adults (adult treatment panel III). JAMA, 2001; 285: 2486-2497.
21. Warnick GR, Myers GL, Cooper GR, Rifai N; Impact of the third cholesterol report from the adult treatment panel of the National Cholesterol Education Program on the clinical laboratory. Clin Chem., 2002; 48: 11-17.
22. WHO Technical Report #727, 1985.
23. Wayne PA; National Clinical Chemistry Laboratories Services (NCCCLS). How to define and determine reference intervals in the Clinical Laboratory; Approved guideline,2nd edition, C28-A2, 20(13). National Committee for Clinical Laboratories Standards, 2000.
24. Horowitz GL; Establishment and use of reference values. In Burtis CA, Ashwood ER, Burns DE; Tietz textbook of clinical chemistry and molecular diagnostics. 5th edition. Philadelphia, 2012: 95-118.
25. Villanova PA; National Committee for Clinical Laboratory standards: how to define, determine and utilize reference intervals in the clinical laboratory: proposed guidelines. 2nd edition, NCCLS Document 2000; C 28-A 2.
26. Friedewald WT, Levy RI, Fredrickson DS; Estimation of the concentration of low density lipoprotein cholesterol without the use of the preparative ultracentrifuge. Clin Chem., 1972; 18: 449.
27. Furruqh S, Anitha D, Venkatesh T; Estimation of reference values in liver function test in health plan individuals of an urban South Indian population. Ind J Clin Biochem., 2004; 19(2): 72-79.
28. Solberg HE, Stamm D; Approved recommendation on the theory of reference values. Part 4: Control of analytical variation in the production, transfer and application of Reference Values. Eur J Clin Chem Clin Biochem., 1991; 29: 531-535.
29. Fonarow GC; National Cholesterol Education Program. Second report of the expert panel on detection, evaluation and treatment of high blood cholesterol in adults (Adult Treatment Panel II). Circulation, 1994; 89: 1329-1445.
30. Kaur V, Verma M, Kaur A, Gupta S, Singh K; To establish the reference intervals of lipid profile in Punjab. Ind J Clin Biochem., 2012; 27(3): 290-295.
31. Das M, Saikia M; Estimation of reference interval of lipid profile in Assamese Population. Ind J Clin Biochem., 2009; 24 (2): 190-193.
32. Durgawale P, Patil S, Shukla PS, Sontakke A, Kakade S, Yadav S; Evaluation of reference intervals of serum lipid profile from healthy population in western Maharashtra. Indian J Clin Biochem., 2009; 24(1): 30–35.
33. Patel A, Patel A, Chakrabarti C; An initial attempt to establish population reference values for lipid profile in apparently healthy people of Ahmedabad-A pilot study. Int J Res Med., 2013; 2(3): 1-4.
34. Malati T, Mahesh MR; Reference intervals for serum total cholesterol, HDL-cholesterol, LDL-cholesterol, triglycerides, Lp (a), apolipoprotein A-I, A-II, B, C-II, C-III, and E in healthy South Indians from Andhra Pradesh. Indian J Clin Biochem., 2009; 24(4): 343-355.
35. Jhala CI, Shah UV, Shah TK, Naik BK, Dafda JD; A study of serum lipid profile part I: Establishment of normal reference values of serum lipid levels in healthy vegetarian population of Gujarat. Ind J Clin Biochem., 1988; 13: 1-7.
36. Goswami K, Bandyopadhyay A; Lipid profile in middle class Bengali population of Kolkata. Ind J Clin Biochem., 2003; 18(2): 127-130.
37. Reddy KS, Prabhakaran D, Chaturvedi V, Jeemon P, Thankappan KR, Ramakrishnan L *et al*.; Methods for establishing a surveillance system for cardiovascular diseases in Indian industrial populations. Bulletin of the World Health Organization, 2006; 84: 461-467.
38. Ashavaid TF, Kondkar AA, Todur SP, Dherai AJ, Morey J, Raghavan R; Lipids, lipoporteins, Apolipoprotein and Lipoprotein (a) levels: reference intervals in a Healthy Indian Population. J Atheroscl Thromb., 2005; 12: 251-9.
39. Li J, Wang J, Li P, Niu Q, Wang S, Jiang L; The investigation of serum lipids and lipoproteins in Beijing (Chinese). Chin Med J., 1988; 68: 327-331.
40. Li Z, Yang R, Xu G, Xia T. Serum Lipid Concentrations and Prevalence of

Dyslipidemia in a Large Professional Population in Beijing. Clin Chem 2005; 51(1): 144-50.

41. Noma A, Hata Y, Goto Y; Quantitation of serum Apolipoprotein A-1, A-II, B, C-II, C-III and E in healthy Japanese by turbidimetric immunoassay: reference values and age – and sex related differences. Clin Chim Acta, 1991; 199: 147-158.
42. Carroll M, Sempos C, Briefel R; Serum lipids of adults 20-74 years, United States, 1976-80, National Center for health Statistics. Vital Health Stat., 1993; 11(2242).
43. Yano K; Distribution and correlates of lipids and lipoproteins in elderly Japanese- American men. The Honolulu Heart Program Arteriosclerosis, Thrombosis and Vascular Biology. 1996; 16: 1356-1364.
44. Concepcion A, Aurora O, Sofia G, Rosa D, Luis FC; Reference intervals for serum lipids, lipoproteins, and apoproteins in the elderly. Clin Chem., 1994; 30(3): 404-406.
45. Zargar AH, WandrooFA, Wadhwa M B, Masoodi SR, LawayBA, Shah NA *et al*.; Serum lipid profile in subjects with varying nutritional status. J Ind Med Assoc., 1996; 9(3): 77-84.
46. Glueck CJ, Gartside P, Fallat RW; Longevity syndromes: Familial hypobeta and familial hyperalpha lipoproteinemia. J Lab Clin Med., 1976; 88: 941-957.
47. Rustad P, Felding P, Franzson L, Kairisto V, Lahti A, Ma°rtensson A *et al*.; The Nordic Reference Interval Project 2000: recommended reference intervals for 25 common biochemical properties. Scand J Clin Lab Invest., 2004; 64: 271-284.
48. Sekimoto H, Goto Y, Goto Y, Naito C, Yasugi T, Okido M *et al*.; Changes of serum total cholesterol and triglyceride levels in normal subjects in Japan in the past twenty years. Jpn Circ J., 1983; 47: 1351-1358.
49. Wang S, Man Y, Li H, Dong J, Tang W, Guo H; Changes in serum total cholesterol levels of Beijing professional population during 1981-2001 (Chinese). Chin J Arterioscler., 2003; 11: 435-438.
50. Pajak A, Williams OD, Broda G, Baczynska E, Rywik S, Davis CE *et al*.; Changes over time in blood lipids and their correlates in Polish rural and urban populations: the Poland-United States collaborative study in cardiopulmonary disease epidemiology. Ann Epidemiol., 1997; 7: 115-124.
51. Ichihara K, Itoh Y, Lam CWK, Poon PMK, Kim JH, Kyono H *et al*.; Sources of variation for commonly measured serum analytes among 6 Asian cities and consideration of common reference intervals. (Science committee for the Asian Pacific Federation of Clinical Biochemistry). Clin Chem., 2008; 54: 356-365.
52. Okayama A, Ueshima H, Marmot MG, Elliott P, Yamakawa M, Kita Y; Different trends in serum cholesterol levels among rural and urban populations aged 40-59 in Japan from 1960 to 1990. J Clin Epidemiol., 1995; 48: 329-337.