International Journal of Food Science and Nutrition
www.foodsciencejournal.com
ISSN: 2455-4898
Received: 16-08-2021, Accepted: 01-09-2021, Published: 17-09-2021
Volume 6, Issue 5, 2021, Page No. 31-33

Biochemical assessment of prediabetic subjects in karimnagar district of Telangana state

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Abstract
Prediabetes was defined as fasting plasma glucose (FPG) of 100 to 125 mg/dl and/or HbA1c of 5.7% to 6.4%. 25 prediabetic subjects those with HbA1C 5.7-6.4% in Karimnagar district of Telangana state were selected for the study. The selected prediabetic subjects were assessed with blood pressure and lipid profile biochemical parameters. Results showed that selected prediabetic subjects had normal systolic blood pressure and stage I hypertension diastolic blood pressure. Results related to lipid profile of the selected prediabetic subjects showed that total cholesterol and LDL cholesterol were desirable while triglycerides and HDL cholesterol were in borderline.

Keywords: prediabetes, HbA1C, blood pressure, lipid profile

Introduction
Prediabetes broadly refers to an intermediate stage between completely normal glucose levels and also the clinical entity of type 2 diabetes, encompassing both impaired fasting glucose (IFG) and impaired glucose tolerance (IGT) (Aroda and Ratner, 2008). Prediabetes was defined as fasting plasma glucose (FPG) of 100 to 125 mg/dl and/or HbA1c of 5.7% to 6.4% (Jeon *et al*., 2013) [2]. Prediabetes significantly increases the threat of developing type 2 diabetes (Guess *et al*., 2015). According to an ADA expert panel, up to 70% of people with prediabetes will eventually develop diabetes (Tabak *et al*., 2012) [4].

Prediabetes is related to demonstrable alterations in insulin sensitivity, pancreatic beta-cell function, inflammatory cytokines, incretin response, and hepatic glucose production (HGP) (Brannick *et al*., 2016) [5]. Health risks related to prediabetes are progression to diabetes, nephropathy and kidney disease, neuropathies, retinopathy and macro vascular disease (Bansal, 2015) [6].

Materials and Methods
Subjects were screened from Karimnagar district between 18-50 years of age and 25 prediabetic subjects whose HbA1C ranged between 5.7-6.4% were selected for this study. The selected prediabetic subjects were estimated for lipid profile and blood pressure.

Collection of blood samples
Blood samples were drawn from the subjects with the help of a trained laboratory technician. Blood samples were collected after a 12 hour overnight fast. Ethical clearance was obtained from institutional ethical committee.

Estimation of lipid profile
Fasting blood samples (2 ml intravenous blood) were collected from each subject by a trained lab technician into gel tubes. The gel forms a physical barrier between serum or plasma and blood cells during centrifugation. Plasma was separated by centrifuging the blood samples (2000-2500 rpm, for 10 minutes) with an hour of collection and transferred into plastic storage vials for further analysis. The serum samples were analyzed for lipid profile (TC, TG, HDL-C, LDL-C).

Total Cholesterol
Total cholesterol was estimated by using cholesterol kit enzymatic method by the method given by modified Roeschlau's method (1974) [7].

Triglycerides
Triglycerides was estimated using triglyceride kit by method of Wako and the modifications by Mc Gowan, 1983 [8] and Fossati and Ann 1969 [9].

HDL Cholesterol
HDL cholesterol was estimated using HDL kit by method of Burstein *et al*, (1970) [10].

LDL Cholesterol
LDL cholesterol was calculated using Friedwald's formula (1972) [11].

LDL mg/dl = Total Cholesterol – HDL Cholesterol – Triglycerides/5

Estimation of blood pressure

Blood pressure was measured with the fully automatic digital upper arm blood pressure monitor. Systolic and diastolic are the two terms that was used to express the blood pressure. The maximum pressure that was exerted during one heartbeat was the systolic pressure. When the pressure was minimal between two heartbeats was the diastolic pressure. The blood pressure was measured in terms of (mm/Hg) i.e., millimeters of mercury. The cuff was wrapped properly around the upper arm and made sure that body posture was right while monitoring the blood pressure. Then on button 52 was pressed and automatically it showed the systolic and diastolic blood pressure at the display screen. The whole measurement process was automatic apart from placing the cuff around upper arm (The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure, 2004) [12].

Results and Discussion

Table 1: Classification of Blood Pressure

Blood pressure	Systolic (mm/Hg)	Diastolic (mm/Hg)
Normal	<120	<80
Elevated	120-129	<80
Hypertension stage 1	130-139	80-89
Hypertension stage 2	>140	>90
Hypertension stage 3	>180	>120

Source: American Heart Association, 2020

Table 2: Mean systolic and diastolic blood pressure of the selected prediabetic subjects

Blood Pressure	Male (n=9)	Female (n=16)	Overall (n=25)
Systolic blood pressure (mm/Hg)	110.78 (3.77)	115.06 (3.04)	113.52 (2.36)
Diastolic blood pressure (mm/Hg)	84.56 (2.82)	82.44 (1.87)	83.20 (1.55)

From Table 1, it can be clearly seen that normal systolic blood pressure was <120mm/Hg and normal diastolic blood pressure was <80mm/Hg. From Table 2, results showed that in males, average mean systolic blood pressure was 110.78mm/Hg (Normal) while in females, average mean systolic blood pressure was 115.06 (Normal) and overall average mean systolic blood pressure was 113.52mm/Hg(Normal). In males, average mean diastolic blood pressure was 84.56mm/Hg (Hypertension stage I) while in females, average mean diastolic blood pressure was 82.54mm/Hg (Hypertension stage I) and overall average mean diastolic blood pressure was 83.20mm/Hg. From the results, it can be clearly seen that as per American Heart Association - 2020, the average systolic blood pressure of prediabetic subjects was 113.52mm/Hg i.e., normal systolic blood pressure but the average diastolic blood pressure of prediabetic subjects was 83.20mm/Hg i.e., Hypertension stage I. The selected prediabetic subjects are in risk of stage I hypertension diastolic blood pressure.

Table 3: Classification of Lipid profile

Lipid profile	Desirable	Borderline	High risk
TC (mg/dl)	<200mg/dl	200-239mg/dl	≥240mg/dl
TG (mg/dl)	<150mg/dl	150-199mg/dl	≥200mg/dl
HDL (mg/dl)	≥60mg/dl	41-59mg/dl	<40mg/dl
LDL (mg/dl)	60-129mg/dl	130-159mg/dl	160-189mg/dl

Source: National Institute of Health – National Cholesterol Education Programme

Table 4: Mean lipid profile of the selected prediabetic subjects

Lipid profile	Male	Female	Overall
TC (mg/dl)	203.67 (8.68)	192.00 (9.94)	196.20 (7.06)
TG (mg/dl)	202.56 (30.92)	155.94 (13.55)	172.72 (14.46)
HDL (mg/dl)	41.78 (0.22)	39.75 (0.23)	40.48 (0.26)
LDL (mg/dl)	121.38 (9.80)	121.06 (10.52)	121.20 (7.47)

Table 3 clearly shows the classification of lipid profile as desirable, borderline and high risk. From Table 4, results showed that in males, average total cholesterol was 203.67mg/dl (Borderline) while in females, average total cholesterol was 192mg/dl (Desirable) and overall average total cholesterol was 196.20mg/dl which means desirable total cholesterol in prediabetes subjects. In males, average triglycerides were 202.56mg/dl (High Risk) while in females, average triglycerides were 155.94mg/dl (Borderline) and overall average triglycerides was 172.72mg/dl which means borderline triglycerides. In males, average HDL was 41.78mg/dl (Borderline) while in females, average HDL was 39.75mg/dl (High Risk) and overall average HDL was 40.48mg/dl which means borderline HDL cholesterol. In males, average LDL was 121.38mg/dl (Desirable) while in females, average LDL was 121.06mg/dl (Desirable) and overall average was 121.20mg/dl which means desirable LDL cholesterol.

The association of dyslipidemia, especially higher triglyceride level and low cholesterol adhered high-density lipoprotein (HDL) with prediabetes, has certain role to play role an independent risk factor for diabetes (Diaz-Redondo *et al*., 2015 and Kang, 2013) [13, 14].

Prediabetes occurs as a consequence of impairment of β-cell functions and insulin resistance. One of the reasons for essential hypertension may be outcome of that insulin resistance. It can be modified by framing oneself in daily modified healthy habitual lifestyle such as by making a habit of regular exercise, reducing salt intake, discontinuing smoking, and feeding healthy diet (Khambalia *et al*., 2011 and Heianza *et al*., 2011) [15, 16].

The increased risk for CVD in prediabetes appears to be due to a combination of related factors common in the metabolic syndrome (insulin resistance, hyperglycemia, dyslipidemia, hypertension, and systemic inflammation) (Cubbon *et al*., 2008) [17]. In particular, insulin resistance appears to promote CVD via effects on BP, endothelial cell function, lipids, platelet function, and blood coagulation (Fonseca, 2007) [18]. Although dyslipidemia is common in prediabetes, insulin-resistant prediabetic individuals who convert to type 2 diabetes also have a higher incidence of an atherogenic pattern of cardiovascular risk factors compared with non-converting individuals (Haffner *et al*., 2000) [19].

Impaired glucose tolerance and insulin resistance are associated with low levels of HDL cholesterol, increases in triglycerides, and hypertension. These metabolic problems in combination with changes in factors involved in the coagulation cascade may result in accelerated atherosclerosis and early macro vascular complications. Impaired glucose tolerance, therefore, should be treated as a

disease that is worthy of clinical screening and intervention' (Edelman, 1995) [20].

Pathophysiology of prediabetes: skeletal muscle insulin resistance, impaired insulin secretion by the pancreatic β cells, dysregulated hepatic glucose production and increased lipolysis are among the documented defects underlying the development of prediabetes (Brannick *et al.*, 2016) [5].

The epidemiological relation between prediabetes and macro vascular disease can be confounded by clustering of vascular risk factors within individuals. Blood glucose in the prediabetic range is correlated with many risk factors, including general and central obesity, blood pressure, and triglyceride and lipoprotein concentrations (The Emerging Risk Factors Collaboration, 2010) [22].

Conclusion

Prevalence of prediabetes in India is increasing at present. Efforts must be done to identify type 2 diabetes in the asymptomatic prediabetes state. Early identification of at-risk persons using simple screening tools and appropriate lifestyle intervention would greatly support in preventing or postponing both the onset of diabetes and its related cardiovascular and microvascular complications thereby reducing the burden on the community and the nation as a whole.

Acknowledgment

The authors thank Honorable Vice Chancellor of Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad for his encouragement.

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