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Nutritional status assessment in Prediabetic subjects of Karimnagar District

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Abstract
Prediabetes refers to fasting plasma glucose of 100 to 125 mg/dl and/or HbA1C of 5.7% to 6.4%**.** The prevalence of type 2 diabetes and prediabetes has been increasing worldwide because of modern lifestyle, unhealthy diet and lack of physical activity. The objective of the study is to know the prevalence of prediabetes among adults aged 18-50 years and to assess their anthropometric values in Karimnagar district, Telangana state, India. A total of 49 adults were screened and found 51.02% of them are prediabetics, 42.85% were normal and 6.12% were diabetes as per HbA1C levels. The nutritional status of prediabetic subjects was assessed through anthropometry and found 44% was categorized as overweight, 32% under class I obese, 16% normal, 4% class II obese and 4% class III obese. Association was found between prediabetes and overweight/obese. The prevalence of prediabetes was higher in overweight/obese persons with higher body mass index.

Keywords: Prediabetes, Prevalence, HbA1C, BMI, Overweight.

Introduction
Prediabetes is defined as an intermediate stage between completely normal glucose levels and the clinical entity of type 2 diabetes, encompassing both impaired fasting glucose (IFG) of 100-125 mg/dl and impaired glucose tolerance (IGT) of 140-200 mg/dl or HbA1C level between 5.7%-6.4% (ADA, 2014; Aroda and Ratner, 2008) [2, 5]. In recent years, the prevalence of type 2 diabetes mellitus and prediabetes has been increasing worldwide because of modern life style, unhealthy diet and lack of physical activity (Errazuriz *et al.*, 2017) [13]. Experts have projected that by 2030 about 472 million people will have prediabetes (Tabak *et al.*, 2012) [21]. Prediabetes is prevalent in the global population, and those affected are at high risk of progression to type 2 diabetes, and also at risk of cardiovascular disease (CVD) (Ferrannini 2014; Colagiuri 2011; Grundy 2012) [14, 10, 15].
Pathophysiology of Prediabetes: skeletal muscle insulin resistance, impaired insulin secretion by the pancreatic β -cells, dysregulated hepatic glucose production, increased BMI and increased lipolysis are among the documented defects underlying the development of prediabetes (Stefan *et al.*, 2016; Brannick *et al.*, 2016; Cubbo *et al.*, 2008) [20, 8, 11]. Prediabetes has been associated with an increased risk for both early microvascular and macro vascular complications (Edwards and Cusi 2016) [12]. Treatment options for prediabetes are lifestyle interventions to improve insulin sensitivity and β-cell function (Bansal, 2015) [7]. For prevention of prediabetes, diet and nutrition play an important role (Errazuriz *et al.*, 2017) [13]. The primary aim of lifestyle interventions is to prevent or delay development of type 2 diabetes and its complications by targeting obesity and physical inactivity, the two most important modifiable risk factors of diabetes development (Heikkila *et al.*, 2012) [16].

Materials and Methods
The study was conducted in Karimnagar district of Telangana state. A purposive sampling technique was used to select prediabetes subjects (based on inclusion and exclusion criteria) in Karimnagar district after written informed consent was obtained from them. Blood samples were drawn from the subjects with the help of a trained laboratory technician. Blood glucose concentrations were estimated by HbA1C test. Inclusion criteria was HbA1C 5.7-6.4% according to ADA (American Diabetic Association) and age 18-50 years**.** Exclusion criteria was age more than 50 years, history of drug or alcohol abuse in prior 6 months and those who use glucose lowering medication. Ethical clearance was obtained from institutional ethical committee.
To assess the nutritional status of the selected prediabetes, anthropometric measurements like height and weight were taken using standard methods. The height of the subjects was measured using standard height rod of 2 meters' length, close to 0.1cm.

Height was measured with bare heels together, buttocks, shoulder and back of the head touching the upright rod and arms lying at the sides in a natural free manner. The weight of the subjects was recorded close to 100 grams using a digital standard weighing machine. While weighing; care was taken to ensure that subjects had minimal clothing and they were asked to look straight with their head and feet to the ground. Generally, the weights were recorded in the morning before taking food. Body mass index (BMI) was calculated using the formula weight in kilograms divided by height in metre².

Results and Discussion

Screening of subjects

The incidence of prediabetes based on HbA1C %. As per the American Diabetic Association (ADA) classification, the subjects who had HbA1C levels 5.7% to 6.4% are considered as prediabetes, <5.7% are considered as normal and > 6.4% are considered as diabetes. In this study, a total of 49 adults were screened and among them 51.02% (n=25) was prediabetics with HbA1C levels in the range of 5.7% - 6.4% 6.12% (n=3) was diabetes and 42.85% (n=21) was normal (Table 1 & fig 1). From the table 1 it clearly indicates that, the occurrence of prediabetes was extremely spiraling and based on the age group the occurrence of prediabetics was high among 40-44 years (72.72%) subjects. However, among male subjects 64.28% were belongs to prediabetes, 7.14% diabetic and 28.57% were normal HbA1C% levels. Further among 35 female subjects; 45.71% were prediabetes, 5.71% were diabetic and 48.57% are having normal HbA1C% levels. From this it clearly indicates that majority of the males (64.28%) subjects were at risk of occurrence of prediabetes when compared to female (45.71%) subjects.

A similar result was found Andes *et al.* (2019) [3] study conducted in the United States, prevalence of prediabetes was significantly higher in male than in female individuals 22.5% vs 13.4% in adolescents and 29.1% vs 18.8% in young adults. Mainous *et al.* (2016) [18] results also showed that among individuals aged 45 years and older, the prevalence of prediabetes increased from 22.0% to 33.1%. Another study by Madhu *et al.* (2018) [17] in urban area of east Delhi and found Prevalence of diabetes was 18.3% (known 10.8% and newly detected 7.5%) among 470 households which included 1317 individuals while Prevalence of prediabetes was 39.5% as per ADA criteria.

Table 1: Age and Sex Distribution of Adults and Prevalence of Prediabetes

Age (years)	Male	Female	Total	Prediabetes (5.7-6.4%)	Diabetes (> 6.4%)	Normal (<5.7%)
18-24	-	3	3	1 (33.33%)	-	2 (66.66%)
25-29	2	5	7	1 (14.28%)	-	6 (85.71%)
30-34	3	7	10	4 (40%)	1(10%)	5 (50%)
35-39	2	8	10	6 (60%)	-	4 (40%)
40-44	4	7	11	8 (72.72%)	1 (9.09%)	2 (18.18%)
45-49	3	5	8	5 (62.5%)	1 (12.5%)	2 (25%)
Total	14	35	49	25 (51.02%)	3 (6.12%)	21 (42.85%)

*Figures in Parenthesis indicates percentages

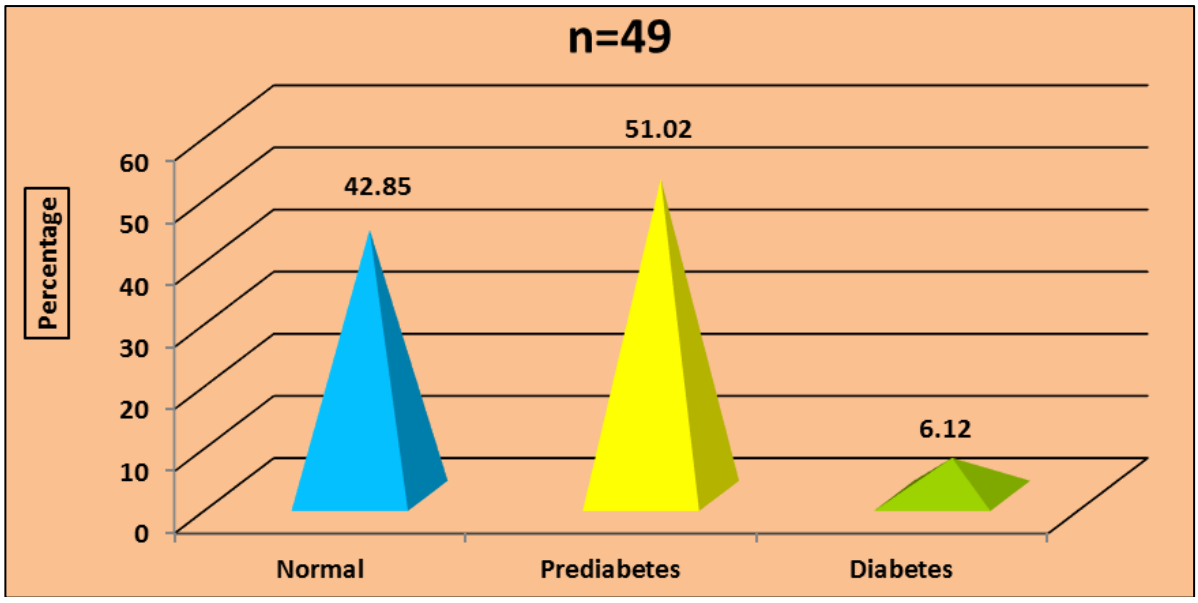

Fig 1: Prevalence of prediabetes among adults

Nutritional status assessment

A total of 25 pre-diabetic subjects was selected who were having HbA1C levels (5.7 -6.4%) and assessed nutritional status through anthropometry. As per WHO, BMI was classified as: "Underweight": BMI <18.5 kg/m², "Normal weight": BMI 18.5–24.9 kg/m², "Overweight": BMI 25–29.9 kg/m², "Class I Obese": BMI 30-34.9 kg/m², "Class II Obese": BMI 35-39.9 kg/m² and "Class III Obese": BMI ≥ 40 kg/m². From (Table 2 & Fig 2), it was observed that majority of the subjects 44% (n=11) were overweight; followed by class I obese (32%; n=8); normal (16%; n=4); while minority of the subjects 4% (n=1) were under class II obese and class III obese which shows increase in BMI i.e., overweight and obesity is one of the major risk factor of prediabetes. In this study, association was found between prediabetes with overweight/obese. The mean age group of 25 prediabetes subjects is 38.2 years. The mean height of 25 prediabetes subjects is 157.43cms. The mean weight of 25 prediabetes subjects is 70.46kgs. The mean BMI of 25 prediabetes subjects is 28.96 kg/m² which means overweight.

A similar study conducted by Andes *et al.* (2019) [3] results showed that prediabetes prevalence was significantly higher in individuals with obesity than in those with normal weight 25.7% vs 16.4% in adolescents and 36.9% vs 16.6% in young adults. Alkandari *et al.* (2018) [1] results showed that pre-diabetes was positively associated with BMI and waist-hip

ratio. BMI ≥ 25 kg/m^2 is a major risk factor for development of prediabetes along with other risk factors like physical inactivity, first degree relative with diabetes mellitus (Tang *et al.*, 2015) [22].

The prevalence of prediabetes was higher in obese person having higher range of BMI (Bala *et al.*, 2019) [6]. From our study results showed that higher BMI was significantly associated with prediabetes.

The American Diabetes Association recommended that "individuals at high risk for developing diabetes must develop awareness of the benefits of weight loss and doing regular physical activity" (Sherwin *et al.*, 2003) [19].

Table 2: BMI classification of the selected prediabetes subjects

BMI Classification	Male Frequency (%)	Female Frequency (%)	Total (%)
Underweight	-	-	-
Normal	1 (11.11)	3 (18.75)	4 (16%)
Overweight	4 (44.44)	7 (43.75)	11 (44%)
Class 1 obese	3 (33.33)	5 (31.25)	8 (32%)
Class 2 obese	1 (11.11)	-	1 (4%)
Class 3 obese	-	1 (6.25)	1 (4%)
Total	9 (100)	16(100)	25 (100)

*Figures in Parenthesis indicates percentage

Fig 2: BMI classification of the selected prediabetic subjects

Conclusion

Prevalence of prediabetes in India is increasing at present. Overweight and obesity became one of the major risk factor of prediabetes. 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.

The present study has certain limitations for generalizability. The data utilized in the study was drawn from a research project which is basically a study on the effect of high fiber composite mix supplementation on glycaemia and lipid profile of the prediabetes subjects. The lipid profile and blood glucose estimation was carried out as a part of the study. The sample size was calculated based on the main study. Hence sample size for estimation of occurrence of prediabetes and for studying the association of risk factors may not be adequate. This study has brought out important points for further studies with sufficiently larger samples to confirm the epidemiological consistency of the observations made in this study.

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