Original Research Paper

Anatomy

PREVALENCE OF PREDIABETES IN HYPERTENSIVES IN SUB-HIMALAYAN REGION.

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ABSTRACT

Introduction: In the screening India's twin epidemic study, diabetes mellitus (DM) and hypertension (HT) were found to coexist in 20.6% patients.
Objective: Study the prevalence of prediabetes and diabetes in hypertensives in Sub-Himalayan region.
Methodology: Cross sectional study was carried out on 40 healthy and 40 hypertensives.
Results: Prevalence of prediabetes in controls was 22.5% and in case of hypertensives, it was 30%. Body mass index (BMI) and waist to height ratio (WHtR) were significant factors in influencing glycosylated hemoglobin (HbA1c).
Conclusion: Results indicate high prevalence of prediabetes among hypertensives. BMI and WHtR suggested as screening tools for prediabetes and diabetes.

KEYWORDS : Body mass index, Glycosylated hemoglobin, Hypertension, Prediabetes, Waist to height ratio

INTRODUCTION

The seventh report of the Joint National Committee (JNC-7) of high blood pressure (BP) defines hypertension (HT) as BP ≥140/90 mm Hg.[1] International Diabetes Federation report of 2017 states that 425 million people have diabetes in the world and out of these, 72 million cases exist in India and by 2045 such cases will rise to 151 million.[2] It further reveals that 45.8% of adults in the South East Asian region have undiagnosed diabetes. The National Family Health Survey-4 indicates the mean prevalence of BP in India to be 22.4% for both men and women.[3] Study by Roy et al in national capital region (NCR) revealed the prevalence of HT increasing from 23% to 42.2% in urban and from 11.2% to 28.9% in rural NCR.[4]

Diabetes mellitus (DM) and HT are interrelated diseases that predispose an individual to atherosclerotic cardiovascular disease.[5] HT is about twice as frequent in DM as in those without.[6] Life style and genetic factors contribute to both HT and DM. HT is a co-morbid condition in DM and vice versa. DM and HT coexist in 40-60% of patients with type 2 DM.[7,8] In India, 50% of diabetic individuals have HT.[9,10] In the screening India's twin epidemic cross-sectional study, DM and HT were found to coexist in 20.6% patients.[11]

The term Prediabetes is an intermediate stage used to describe impaired blood glucose tolerance levels of fasting between 100 mg/dl and ≤ 125 mg/dl of blood or whose 2-hour postprandial blood glucose is 140-200 mg/dl.[12] Studies in India have shown that 40-55% of people with prediabetes stage will convert to type-2 DM over 3-5 years.[12] The American Diabetes Association uses a lower cut off value for impaired fasting glucose (IFG) as ranging from 100 mg/dl to 125 mg/dl and has added glycosylated hemoglobin (HbA1c) ≤ 6.4% to avoid under estimation.[13,14] Once diabetes sets in, it brings in a lot of metabolic changes. However, the reassuring news is that prediabetes is a stage where one can prevent its conversion to type-2 DM.[15] Following a healthy diet and maintaining a physically active lifestyle, one can bring the blood glucose level back into the normal range.[15]

This study aims to identify and explore impaired glucose tolerance among subjects who were already on anti-hypertensive therapy, thereby estimating the burden of prediabetes and undiagnosed type-2 DM in such hypertensives. Study results will contribute to better management of hypertensive patients.

MATERIALS & METHODS

The study was carried out in Department of Anatomy and Biochemistry, Dr Rajinder Prasad Government Medical College, Kangra at Tanda, Himachal Pradesh after obtaining approval from Institutional Ethics Committee. Sampling population comprised of adult subjects randomly selected after due informed consent coming to centralized collection centre of the hospital and Civil Hospital, Kangra.

The sample size comprised of 40 healthy controls and 40 subjects on anti-hypertensive therapy. The BP of subjects was recorded by AG safe check upper arm digital BP monitor (AG-1010) after rest for 10 minutes on the left arm sitting posture. Height was recorded against vertical wall with flexible measuring tape. Waist circumference was measured at level of umbilicus with flexible measuring tape. Weight was recorded with same standard digital weighing machine. BMI and body surface area (BSA) were calculated as per the formula obtained from the website www.medcalc.com.

Fasting venous blood sample of subject's approximately 6 ml was collected; 3 ml in ethylene diamine tetra acetic acid (EDTA) tube and 3 ml in plain tube. Whole blood sample was used for HbA1c estimation using Nyco card (Alere Technologies AS, Oslo, Norway) reader. Serum obtained was analyzed for fasting blood sugar (FBS) by XL 300 (Erba, Mannheim, Germany) automated chemistry analyzer using commercially available kit (Transasia Bio-Medicals Ltd., Baddi, India).

The data was analyzed using Statistical Package for Social Sciences (SPSS) software version 19. Data was expressed as mean ± standard deviation (SD) for different variables.

RESULTS

Descriptive characteristics of the study population are exhibited in Table 1.

Subjects having FBS > 100 mg/dl and ≤ 125 mg/dl and HbA1c > 5.6% and ≤ 6.4% were labelled as prediabetic. Table 2 provides descriptive data on prediabetes in healthy control and among hypertensive cases. Figure 1 shows the prevalence of prediabetes in the two study groups viz. control and hypertensive.

Table 1: Characteristics of Study Population.

| | Healthy Controls | | | | | Hypertensive Cases | | | | |
| | Total n=40 | Male n=23 | | Female n=17 | | Total n=40 | Male n=23 | | Female n=17 | |
Statistic	Mean	Mean	SD	Mean	SD	Mean	Mean	SD	Mean	SD
Age	49.33	51.09	11.09	46.94	11.08	57.43	58.78	12.19	55.59	8.62
Weight	62.71	63.83	15.80	61.18	8.83	69.17	72.87	12.42	64.15	9.33
Height	163.20	168.70	8.71	155.76	5.36	163.45	170.17	5.24	154.35	7.59
BMI	23.48	22.17	3.96	25.25	3.96	25.90	25.17	4.00	26.88	3.02
BSA	1.67	1.72	0.24	1.60	0.24	1.75	1.84	0.15	1.62	0.15
Waist Size	88.18	86.96	11.10	89.82	9.41	96.18	96.78	9.73	95.35	7.60
WHtR*	0.54	0.51	0.05	0.57	0.06	0.59	0.57	0.06	0.62	0.04
Diet*	0.65	0.74	0.44	0.53	0.50	0.58	0.61	0.49	0.53	0.50
FBS mg/dl	92.05	89.48	15.21	95.52	13.79	98.61	98.71	15.64	98.47	10.25
HbA1c%	5.51	5.48	0.39	5.54	0.35	5.68	5.61	0.47	5.76	0.41
Occupation*	0.68	0.57	0.50	0.82	0.38	0.33	0.22	0.41	0.47	0.50
Exercise*	0.83	0.91	0.28	0.71	0.46	0.65	0.74	0.44	0.53	0.50

Notes: WHtR: Waist to Height Ratio; Diet (Non Veg:1, Veg:0); Occupation (Moving:1, Sitting:0); Exercise (Yes:1, No:0)

Table 2: Characteristics of Prediabetes in Control and Cases

| | Prediabetes in Healthy Controls | | | | | Prediabetes in Hypertensive Cases | | | | |
| | Total n=9 (22.5%) | Male n=5 (12.5%) | | Female n=4 (10%) | | Total n=12 (30%) | Male n=5 (12.5%) | | Female n=7 (17.5%) | |
Statistic	Mean	Mean	SD	Mean	SD	Mean	Mean	SD	Mean	SD
Age	51.89	51.60	10.56	52.25	2.77	61.50	63.00	8.81	60.43	6.90
Weight	68.21	74.52	16.88	60.33	4.16	67.48	70.00	12.21	65.67	6.76
Height	166.78	172.8	7.83	159.25	5.67	159.58	168.60	2.73	153.14	7.32
BMI	24.29	24.68	4.35	23.80	1.22	26.60	24.68	4.44	27.97	1.77
BSA	1.76	1.87	0.24	1.62	0.08	1.70	1.79	0.13	1.63	0.12
Waist Size	93.22	96.60	10.01	89.00	3.67	98.21	97.90	9.35	98.43	6.11
WHtR*	0.55	0.55	0.05	0.56	0.01	0.62	0.58	0.06	0.64	0.02
Diet*	0.56	0.60	0.49	0.50	0.50	0.42	0.60	0.49	0.29	0.45
FBS mg/dl	110.42	107.6	5.20	113.95	8.40	111.83	116.00	13.46	108.86	6.62
HbA1c%	6.02	6.02	0.10	6.03	0.04	6.10	6.08	0.12	6.11	0.14
Occupation*	0.56	0.40	0.49	0.75	0.43	0.25	0.20	0.40	0.29	0.45
Exercise*	0.67	0.80	0.40	0.50	0.50	0.25	0.40	0.49	0.14	0.35

Notes: WHtR: Waist to Height Ratio; Diet (Non Veg:1, Veg:0); Occupation (Moving:1, Sitting:0); Exercise (Yes:1, No:0)
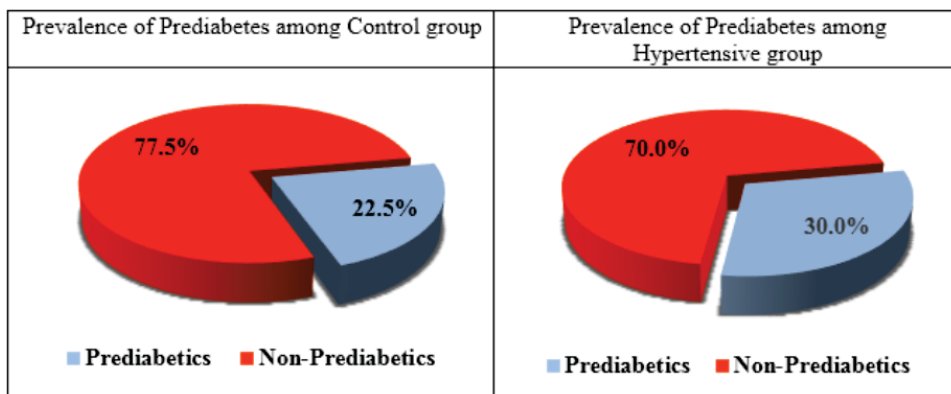
Figure 1: Prevalence of Prediabetes in Study group: Control and Hypertensive

Most of the cases of prediabetes were seen in the age group of 50-59 years. The mean FBS and the mean HbA1c in the prediabetic hypertensive cases were 111.83 mg/dl and 6.10 %. The subjects having prediabetes were 12 and 1 case of undiagnosed diabetes was detected. The percentage prevalence of prediabetes and diabetes was 30% and 2.5%. Most of the prediabetes in the hypertensive cases was seen in the age group of 47-56 years. Percentage of non-vegetarians in the hypertensive prediabetic population was 42%. The lone hypertensive case with diabetes was 50 years non-vegetarian male with a FBS of 130 mg/dl and HbA1c of 6.6%. His waist size was 100.5 cm, BMI 25.1 kg/m2 and WHtR was 0.62.

Multiple regression was performed to determine antecedent factors influencing HbA1c among control and hypertensive study population (Table 3). A p-value of < 0.05 was considered statistically significant. Gender (p = 0.486), occupation (p = 0.678) and diet (p = 0.511) did not show any significant role in determining HbA1c levels. BMI (p = 0.023) and WHtR (0.001) were the only significant antecedents of HbA1c.

Table 3. Multiple Linear Regression Analysis in Control and Cases

Statistic	Coefficients	Standard Error	t-Stat	p-value
Age (Years)	0.003	0.005	0.575	0.567
Gender*	0.078	0.112	0.700	0.486
Occupation*	0.043	0.103	0.418	0.678
Diet*	-0.069	0.104	-0.661	0.511
BMI(Kg/m²)	-0.057	0.025	-2.327	0.023
WHtR	5.500	1.619	3.396	0.001

*Gender (Male:1, Female:0); Occupation (Moving:1, Sitting:0); Diet (Non Veg:1, Veg: 0)
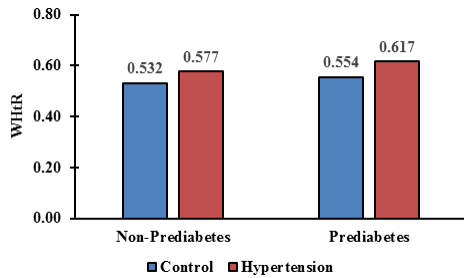
Figure 2: Mean WHtR of Study Group: Control and Hypertension.
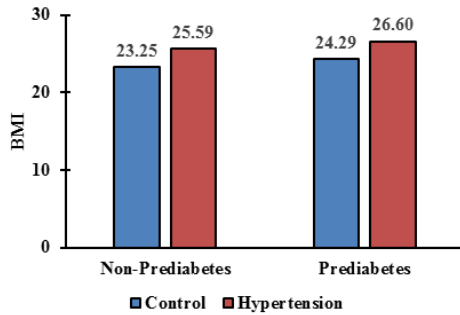
Figure 3: Mean BMI of Study Group: Control and Hypertension.

Further, a comparison of the two significant factors WHtR and BMI in the two groups is shown (Figure 2 and Figure 3). Chi-square test for independence was used to determine whether there was any significant relationship between the categorical variables diet, gender and exercise and the categorical variable prediabetes status (non-prediabetic and prediabetic). Chi-square test of independence revealed a significantly higher percentage of respondents among non-prediabetics doing exercise as compared to the prediabetic group (p value 0.003). No significant differences between diets (veg and non-veg) (p value 0.155) and gender (p value 0.306) among the two groups was observed.

DISCUSSION
The prevalence of prediabetes in this study among the healthy population of Tehsil Kangra and adjoining areas was 22.5% while the prevalence of DM and prediabetes in the hypertensive population was 2.5% and 30%. Such high prevalence indicates unhealthy lifestyle of the population. Results are in proximity to similar studies by Noh et al[16]Vinodhini et al[17] and Shrestha et al.[18]

CONCLUSION
Results indicate high prevalence of prediabetes both in healthy and hypertensive population. BMI and WHtR should be included as primary screening tools for prediabetes and diabetes in both healthy and hypertensive population. Regular physical exercise should be promoted and made a part of daily healthy routine. Regular counselling and vigorous health education campaigns should be promoted to prevent the risk of development of type-2 DM.

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