ORIGINAL RESEARCH PAPER
Volume - 9 | Issue - 12 | December - 2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

PERCEPTION OF DIABETES MANAGEMENT AND CARDIOVASCULAR DISEASE RISK AMONG ADULTS POPULATION WITH PREDIABETES IN NORTH-WEST RAJASTHAN

Physiology

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ABSTRACT

The aim of this study was to explore the perception and understanding of adults with prediabetes about their illness control, risk for CVD and their adherence to healthcare management plans in community. Design: This was a hospital based cross sectional study.Methods: Prediabetic subjects was identified from first degree relatives of type 2 DM Patients, enrolled in diabetic research centre P.B.M. hospital Bikaner.Data were collected in approximately 6 to 10 months semi-structured interviews and analysed using content analysis. Results: Data analysis revealed four themes: (a) Perception of diabetes control; (b) Perception of cardiovascular disease risk; (c) Coping with disease-imposed limitations; and (d) Information validation. Conclusion: The study concludes that the perception of disease control does not necessarily coincide with actual disease control. Examining patients with prediabetes perception and knowledge of their healthcare management and increased CVD risks is essential. An individualized culture and gender-sensitive health education and counselling involving spouses are recommended. Social media to disseminate scientific valid health instructions can enhance adherence. Clinically relevant biochemical & hematological parameters may play a role in the early development of type 2 diabetes. Further research is necessary to study the gender-specific contribution of hematological parameters to the pathogenesis of prediabetic states and finally to the manifestation of type 2 diabetes.

KEYWORDS

Prediabetes, Diabetes, Cardiovascular Disease Risk, Perception

INTRODUCTION

Diabetes mellitus (DM) is a lifelong chronic disease that is spreading worldwide and affects the individual, family and community, causing a substantial increase in morbidity and mortality. The prevalence of type 2 diabetes is increasing worldwide and exhibits a challenge on the health care system as well as on the public health and socioeconomic development of all nations [1]. The causes of type 2 diabetes are multifactorial and result from a combination of environmental and genetic risk factors [2]. The implementation of preventive measures in populations and the identification of high risk groups, which mostly benefit from such activities, will be the key point for the early prevention of type 2 diabetes and its complications. Within the last years, a number of potential risk factors for type 2 diabetes have been identified. In this context, one's attention was particularly turned on lifestyle risk factors, inflammatory parameters, metabolic abnormalities, and genetic risk factors, many of which have been found to be independently associated with type 2 diabetes [3]. Among those risk factors, routinely measured hematological parameters, such as White Blood Cell (WBC) count and hematocrit (HCT) level were associated with insulin resistance and incident type 2 diabetes [4-8]. Hematocrit is positively correlated with hyperinsulinemia and risk factors associated with insulin resistance, e.g. high blood pressure, elevated serum triglycerides, low HDL cholesterol, and central obesity and could therefore be related to insulin resistance. Furthermore, hematocrit is a major determinant of blood viscosity. Increased blood viscosity also contributes to the development of insulin resistance [5-9]. In addition, chronic inflammation is involved in the pathogenesis of type 2 diabetes and evidence from epidemiological studies suggests an association between total WBC or leukocyte count, a non-specific marker of inflammation, and diabetes risk [10]. However, only a few prior studies investigated, whether selected hematological parameters such as WBC count, Mean Platelet Volume (MPV) or red cell count are related to prediabetic states [11-12]. Population-based cohort studies on subjects with and without CVD and diabetes mellitus (DM) at presentation have demonstrated that the mortality rates due to these conditions were greater in those with MetS [13]. It is well accepted that the metabolic syndrome increases the risk for the development of cardiovascular disease, type 2 diabetes, stroke and cancer [14].

So far, to the best of our knowledge, there is no population-based study, which investigated the association between various routinely measured biochemical, hematological parameters and prediabetes. Therefore, the aim of the present study was to identify the existence of prediabetes in first degree relatives of type 2 DM, to assess various predisposing factors for diabetic and cardiovascular risk, to estimate the biochemical and blood parameters for study group (prediabetic) and to investigate the associations of hematological parameters, including HCT, Hemoglobin (HGB), Platelet Count (PC), Mean Platelet Volume (MPV), and WBC count with prediabetic groups (Isolated Impaired Fasting Glucose) HbA1c and newly diagnosed as well as known diabetes mellitus in a population of 32-81year old men and women in P.B.M. hospital Bikaner. Prediabetic subject was identified from first degree relatives of type 2 DM Patients, enrolled in diabetic research centre P.B.M. hospital Bikaner. Prediabetics (Impaired fasting glucose) subjects was identified on the basis of fasting blood glucose 100 to 125 mg/dl and HbA1C (5.7% TO 6.4%) as per American Diabetic Association (ADA) [15] 2011 guidelines. To investigate whether there are sex-specific particularities, in addition all analyses were performed separately for men and women. [15].

Research Design and Methods

Design of Study

A hospital based cross sectional study

Setting

This study was carried out at Department of Physiology, S.P. Medical College & Hospital in collaboration with diabetic research centre P.B.M. hospital Bikaner (Rajasthan).

Study Population

Prediabetic subjects was identified from first degree relatives of type 2 DM Patients, enrolled in diabetic research centre P.B.M. hospital Bikaner. Prediabetics (Impaired fasting glucose) subjects was identified on the basis of fasting blood glucose 100 to 125 mg/dl and HbA1C (5.7% TO 6.4%) as per American Diabetic Association (ADA) 2011 guidelines.[15] We were taken sample size 142.

Study Period & Study Approval

Present study data was collected in approximately 6 to 10 months.The Institutional Ethical Committee at the Sardar Patel Medical College and Associated Group of P.B.M. Hospitals, Bikaner, Rajasthan, India, approved the study. The Developmental Research Committee at the Rajasthan University of Health Sciences, Jaipur, India, was also approved the study.

Study Protocol
The following criteria are undertaken for the selection of the patients in the study:-

Sampling technique
Consecutive sampling was conducted till sample size satisfied during the period of study.

Inclusion criteria & Exclusion criteria
Exclusion criteria
- Subjects having FPG ≥126 mg/dl.
- Subjects having HbA1C below 5.7% and higher than 6.4%
- Subjects taking lipid lowering drugs, dugs to control blood sugar, hormonal therapy, hormonal contraceptives
- Subjects having known endocrinal, renal, cardiovascular disorders will be excluded.
- Age below 20 and over 74 years old

Inclusion criteria
For study group
- Subjects having FPG between 100-125 mg/dl
- Subjects having HbA1C between 5.7% to 6.4%
- 20-74 years age group subjects
- 'Only those patients' who gave informed written consent was included in study.

Tool of data collection
Pre structured Performa was used to collect general information, socio demographic information, baseline physical characteristics, personal habits, biochemical analysis, and for blood parameters.

Statistical Analysis
Numerical variables were reported in terms of mean and standard deviation. Statistical analysis of results was done by normal distribution 'Z' test. In this analysis, variables showing p value less than 0.05 and 0.001 were considered to be statistically significant and highly significant respectively. Correlation coefficient (r) was calculated for finding correlation between two biochemical parameters by using Pearson two-tailed analysis.

RESULTS
Characteristics of the study sample according to as per American Diabetic Association (ADA) 2011 guidelines criteria age wise Pre-Diabetic Subjects are shown in Table 1. Age wise distribution in Pre-Diabetic Subjects were found 30-34 years in maximum 48; 33.80% with prediabetes, 35-39 years (29;20.42%) while 40-44 & 45-49 years (17;11.97%) and minimum only 55-59 years age group were found (1;0.70%) in Pre- Diabetic Subjects out of 142 total subjects.Table 2 shows the Gender wise distribution in Pre- Diabetic Subjects where the Pre- Diabetic Subjects subject (91;64.08%) were male and (51;35.92%) were female out of both 142 in Pre- Diabetic Subjects. Table 3 shows the anthropometric measurements of the subjects with prediabetes. As expected, Mean ± SD levels of BMI (kg/m^2) (25.18±4.76), Waist Circumference (WC) (92.33±13.20), Waist to Hip Ratio (Wc/Hc) (0.9195±0.09), Systolic blood pressure (SBP) (130.06±14.38), Diastolic blood pressure (DBP) (82.26±7.09) showed marked difference and were statistically significantly in prediabetes in compare with diabetic. Biochemical parameters of the individuals studied in the present study are given in the (Table 4). Mean ± SD levels of Fasting Glucose(FBS) (116.92±6.14), Triglycerides (TG) (3.50±0.81), Total Cholesterol (TC) (186.57±20.53), LDL-C (109.66±22.13), VLDL-C (30.84±3.88) were significantly altered and HDL-C (3.50±0.81) to diabetic subject. Table no.5 show the Hematological Parameters in Pre- Diabetic Subjects Mean ± SD were also altered with compare to diabetic group. Table no.6,7,8 were Comparison of Baseline Physical Characteristics, biochemical and Hematological Parameters among Normotensive, Pre hypertensive & Hypertensive Pre diabetic Subjects. These all results were found significantly altered almost Table no.6-8.

Table 1: Age wise distribution in Pre- Diabetic Subjects

Age (yrs)	No. of patients	Percentage
30-34	48	33.80
35-39	29	20.42
40-44	17	11.97
45-49	17	11.97
50-54	18	12.68
55-59	1	0.70
60-64	5	3.52
65-69	5	3.52
≥70	2	1.41
Total	142	100.00

Table 2: Gender wise distribution in Pre- Diabetic Subjects

Gender	No. of patients	Percentage
Male	91	64.08
Female	51	35.92
Total	142	100.00

Table 3: Baseline Mean±SD of Anthropometric Physical Characteristics in Pre- Diabetic Subjects

Parameters	Mean ± SD	Median	Range
Age (Years)	41.18±10.45	38	30-74
BMI (kg/m2)	25.18±4.76	24.6	17.2-41.7
WC (cm)	92.33±13.20	91.44	60.96-139.7
W/H Ratio	0.9195±0.09	0.899	0.697-1.652
SBP (mmhg)	130.06±14.38	130	86-164
DBP(mmhg)	82.26±7.09	80	70-100

Table 4: Biochemical Parameters in Pre- Diabetic Subjects

Parameters	Mean ± SD	Median	Range
Total Cholesterol	186.57±20.53	190.5	152-218
TG	156.38±19.76	154	126-194
HDL	45.92±6.46	47	31-60
LDL	109.66±22.13	116.5	71-152
VLDL	30.84±3.88	30.5	25-38
TG/HDL	3.50±0.81	3.34	2.26-5.74
LDL/HDL	2.48±0.78	2.4	1.26-4.45
AIP Ratio	0.170±0.09	0.153	0.003-0.399
HbA1C	6.03±0.27	6.1	5.4-6.4
FBS	116.92±6.14	118	100-125

Table 5: Hematological Parameters in Pre- Diabetic Subjects

Parameters	Mean ± SD	Median	Range
RBC	4.80±0.59	4.81	3.75-8.28
WBC	8.72±2.02	8.45	4.6-15.5
Lymphocyte %	40.99±7.93	41.1	23.6-57.4
Monocyte %	7.67±2.28	7.40	3.6-15.4
Granulocyte%	51.19±8.96	51.30	33-72.3
HB	13.19±1.68	13.6	8.4-16.2
HCT	40.61±4.90	41.5	25.29-51.3
MCV	84.04±11.90	86	55-108
MCH	27.66±3.59	27.75	14.3-39.1
MCHC	32.50±2.76	31.95	26.0-44.9
RDW-CV	14.63±1.30	14.40	12.7-21.7
Platelet	269.38±80.41	265	105-503
RDW-SD	44.74±4.05	44	33-65

Table 6: Comparison of Baseline Physical Characteristics among Normotensive, Pre hypertensive & Hypertensive Pre diabetic Subjects

Parameters	Normotensive (n=27)	Pre-Hypertensive (n=79)	Hypertensive (n=36)	P-Value
Age (Years)	39.03±9.91	39.32±9.58	46.86±10.43	0.0006
BMI (kg/m2)	23.35±4.47	25.16±4.77	26.61±4.59	0.026
WC (cm)	87.17±24.53	91.52±12.72	97.97±13.64	0.003
W/H Ratio	0.89±0.06	0.91±0.10	0.93±0.86	0.259
SBP (mmhg)	110.29±6.21	128.18±6.54	149.0±9.73	<0.0001
DBP(mmhg)	75.25±10.03	81.59±6.08	87.22±6.62	<0.0001

Table 7: Comparison of Biochemical Parameters among Normotensive, Pre hypertensive & Hypertensive Pre diabetic Subjects

Parameters	Normotensive (n=27)	Pre-Hypertensive (n=79)	Hypertensive (n=36)	P–Value
Total Cholesterol	184.11±21.40	185.46±20.82	190.83±19.10	0.374
TG	149.25±18.41	154.30±19.03	166.30±19.09	0.0009
HDL	47.59±6.12	46.11±6.47	44.25±6.48	0.117
LDL	107.07±22.03	108.88±22.53	114±21.2	0.417
VLDL	29.44±3.69	30.46±3.72	32.7±3.76	0.001
TG/HDL	3.22±0.81	3.43±0.78	3.85±0.79	0.005
LDL/HDL	2.32±0.73	2.45±0.80	2.67±0.78	0.206
AIP Ratio	0.13±0.09	0.16±0.09	0.21±0.09	0.003

Table 8: Comparison of Hematological Parameters among Normotensive, Pre hypertensive & Hypertensive Pre diabetic Subjects

Parameters	Normotensive (n=27)	Pre-Hypertensive (n=79)	Hypertensive (n=36)	P – Value
RBC	4.75±0.81	4.85±0.53	4.73±0.51	0.512
WBC	8.14±1.50	8.69±2.23	9.22±1.78	0.110
Lymphocyte %	43.22±7.10	40.40±8.52	40.60±7.02	0.267
Monocyte %	7.54±2.26	7.78±2.39	7.53±2.10	0.811
Granulocyte%	49.03±8.07	51.14±10.89	52.0±8.10	0.478
HB	13.07±2.09	14.80±14.13	13.2±1.40	0.659
HCT	39.38±6.33	40.99±4.63	40.70±4.21	0.339
MCV	80.17±18.04	85.01±8.33	84.8±12.6	0.171
MCH	29.91±12.52	27.41±3.28	29.9±10.5	0.187
MCHC	32.94±3.67	31.73±4.68	32.6±2.02	0.304
RDW-CV	14.85±1.51	14.59±1.12	14.6±1.50	0.618
Platelet	276.67±115.04	275.58±70.61	248.0±72.40	0.198
RDW-SD	44.66±3.92	44.79±4.11	44.7±4.13	0.985

Figure 1. (Adapted from Potenza et al; Am J Physiol Heart Circ; 2005.)[18]

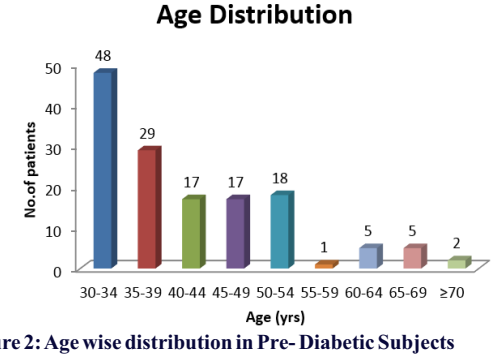

Figure 2: Age wise distribution in Pre- Diabetic Subjects

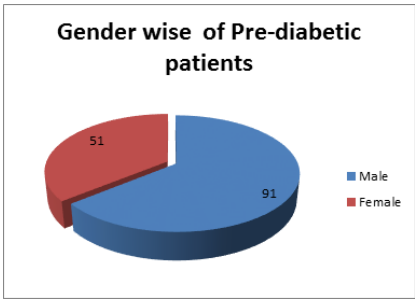

Figure 3: Gender wise distribution in Pre- Diabetic Subjects

DISCUSSION

In the present hospital based study, the circulatory biochemical lipid profile which is marker of CVD concentrations were significantly associated with Normotensive, Pre hypertensive & Hypertensive Pre diabetic Subjects after multivariable adjustment. While RBC, WBC count showed a non-significant relationship with Normotensive, Pre hypertensive & Hypertensive Pre diabetic Subjects and known diabetes. In addition, while we observed no significant association between platelet count and impaired glucose regulation, MPV was significantly associated with known diabetes only. The observed associations were stronger in women than in men.

Most studies on this issue included men only or did not conduct sex-specific analysis [16-18]. Thus, the present study confirms prior findings on an association between HCT, WBC count and diabetes and extends the current knowledge regarding the sex-specific relationship of different hematological parameters and prediabetic states in persons from the general population.

The goals of diabetes management are to maintain the normal level of blood glucose, reduce risks, prevent or delay complications, decrease mortality and maintain a good quality of life (American Diabetes Association, 2011).[15] In the current study, participants' discussion revealed several health issues related to their perception of illness and its complications and their self-efficacy in diabetes management. The participants comprehend the chronicity of diabetes and its complications and believe that it is not serious as long as it is controlled with the absence of complications.

Most complications acknowledged were hypoglycaemia, hyperglycaemia, renal failure and foot ulcers. CVDs were not discussed as an expected complication; this indicates a lack of awareness that diabetes puts patients at an increased risk for CVDs, particularly CHD and stroke. In the current study, the participants' biographical, anthropometric parameter and biochemical data show increased risk factors for CVD complications.

Several challenges facing patients in the self-management of diabetes are maintaining blood glucose levels, managing complications and risk factors of diabetes and successful preventing complications. In exploring patients' perception of self-care abilities, it was found that they all believe in their ability to control blood glucose level and adherence to glucose-lowering medications and diet; however, their clinical data showed poor glycaemic control. Contrary to the current study, Lange and Piette (2006) [19] found that patients' belief in their ability to control their diabetes was a good indicator of actual glucose control.

A major finding being reported in this summary is that the prevalence of prediabetes in the rural community is much higher than speculated. We have reported on CVD risk assessment in prediabetes and undiagnosed diabetes mellitus (UDM) in Nigeria [20]. Appropriate glycaemic control is crucial to delay or prevent the progression of diabetes [21], and a few points are pertinent to emphasize, which made this report update imperative.

In present study it is also observed that the increasing in age was significantly associated with higher risk of T2DM. Bhalerao (2013) [22] and Howard (2004) [23] had reported the similar results. This may be due to prolonged exposure to stress, obesity, genetic factor, advancement of age. The high prevalence among young adults 30-39 years (4.9%), the most productive age group of the community is unacceptable and hence focus on prevention of diabetes among young is essential. [23]

The present study showed that BMI as well as other anthropometric parameter is a significant predictor of development of diabetes and strongly associated with Normotensive, Pre hypertensive & Hypertensive in Prediabetic Subjects. Several studies reported anthropometric parameter as an independent risk factor for development of diabetes.[24] The present study also supported the evidence among Indian, even at lower BMI, there was high odds of diabetes (adjusted OR 2.1). Hence early identification of high BMI would be helpful for primary prevention and early diagnosis of diabetes. Khan et al. reported that in obese individuals, adipose tissue releases increased amounts of non-esterified fatty acids, glycerol, hormones, pro-inflammatory cytokines and other factors that are involved in the development of insulin resistance.[25]

Prior studies have found that biochemical & hematological parameters play an important role in insulin resistance [21,22,25]. The pathophysiological mechanisms by which HCT could influence glucose metabolism are not entirely clear. Insulin increases the transcapillary movement of albumin and as a consequence the plasma volume will decrease and cause an increase of the HCT [23]. Higher HCT levels imply higher blood viscosity, which may predispose to insulin resistance and type 2 diabetes by limiting delivery of glucose, insulin, and oxygen to metabolically active tissues [24]. HGB is an important Nitric Oxide (NO) buffer and a modulator of NO bioavailability and thus involved in the regulation of endothelial function [25]. Additionally, there is a positive association between hemoglobin and sCD40L level, a pro-inflammatory marker released by activated platelets, which predicts cardiovascular events in patients with high-risk atherosclerotic lesions and is elevated in persons with prediabetes and diabetes [26].

In addition to diabetes whose incidence is on the rise, there is the issue of oxidative stress, which is a CVD risk factor that is common in LMIC such as Nepal and Nigeria [17]. There is scientific underpinning for exercise therapy and nutrition to manage and prevent oxidative stress in diabetes [22–25] thus CVDs. Given our observation on physical activities, lifestyle changes for stress management and the behavioural change wheel remains one of our research in phase two.

CVD is established as a leading contributor to the burden of diseases and mortality [20,22], and estimated figures are presented (Fig. 1). Some of the burdens or deaths are preventable since they are due to avoidable risk factors such as unhealthy diet, physical inactivity and smoking [23]. Yet, there is paucity of reports on DM and dyslipidaemia, and where the reports are available they are based on studies in urban areas [26]. Thus, it is important to equally focus research in urban and rural areas.

CONCLUSION

Most people with diabetes do not have the advantage of having continuous assistance and supervision from their healthcare professionals. Effective management of prediabetes requires partnership between the person with diabetes and healthcare professionals. Addressing patient's knowledge, perception of illness control and their actual health behaviour necessitates continuous evaluation and monitoring to guide the plan of care that is culture and gender-sensitive. Therefore, healthcare providers need to maintain an ongoing assessment of the individualized risk factors for CVD and barriers to preventive and healthy behaviours to provide appropriate support and counselling. Using social media to disseminate reliable scientific information and involving the spouse in teaching preventive measures improve self-care management outcomes. Further studies are recommended to examine the effect of educational programmes using social media health messages on self-care management and disease outcome of patients with prediabetes.

Acknowledgements

Dr.B.K. Binawara, Professor, Guide is the study principal investigator. The authors are grateful to Professor for his helps in scientific discussion and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable.

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