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Comparison of factor loadings for anthropometric and physiometric measures among type 2 diabetic males, pre- and post-menopausal females in North Indian Punjabi population

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ABSTRACT

Background: The objective of the present study was to compare the relationship of anthropometric and physiometric characteristics using principal component factor analysis among three groups of type 2 diabetic subjects such as males, pre- and post-menopausal females in North Indian Punjabi population. Method: A total of 349 type 2 diabetic subjects (males 157; females 192; 88 pre- and 104 post-menopausal) were ascertained for the present study. Different anthropometric and physiometric measurements were taken. Principal component factor analysis (PCFA) was applied to identify the components which are more close to type 2 diabetes among the three groups. Results: PCFA revealed five uncorrelated components which explained 79% of the total variance among diabetic males and six unrelated components which explained 78% of the total variance among pre- and post-menopausal females. The important two factors could be identified as central obesity (factor 1) and blood pressure (factor 2) among these three groups. Conclusion: Higher clustering of obesity and blood pressures were found in diabetic males as compared to pre- and post-menopausal diabetic females in North Indian Punjabi population whereas, waist to hip ratio (WHR) has maximum loading in post-menopausal females as compared to others.

Keywords: Factor Analysis; Blood Pressure; Type 2 Diabetes; Anthropometry; Punjabi Population

1. INTRODUCTION

The relationships between type 2 diabetes mellitus (T2DM), anthropometric variables and blood pressures are statistically complex [1,2]. Strong inter-correlation between anthropometric and physiometric variables creates complexities in the analysis and interpretation of independent associations of these variables with the development of type 2 diabetes. Principal Component Factor Analysis (PCFA) is the technique to reduce a large number of variables to a smaller number of factors which are more closely associated with antecedent [2-4]. The objective of the present study using principal component factor analysis is to compare the relationship between anthropometric and physiometric components with diabetic males, pre- and post-meno-pausal females in North Indian Punjabi population. The attention has also been given to find out which factors can be used as significant predictors of T2DM.

2. MATERIALS AND METHODS

Present study was conducted at the different clinical centres such as Heart Station and Diabetic Clinic, A.P. Hospital and Heart Care Centre, Diabetic Clinic and Research Institute in Amritsar district in the state of Punjab among Punjabi population. Punjabi population may be defined as similar genotype groupings and aggregate of similar cultural practices, life style pattern, social influence and similar ethnic characteristics with Punjabi language speaking and at least reside in Punjab for the last 20 years. A total of 349 type 2 diabetic individuals participated in the baseline examination for the present study which occurred from October 2008 to September 2009. Among total individuals 157 and 192 are males and females respectively whereas, among females 88 and 104 are pre- and post-menopausal. All participants provided written informed consent.

2.1. Anthropometric Measurements

Actual age and age on the onset of the disease were recorded from the subject's health card provided by the

clinical centres. Height, weight, circumferences of waist (WC), hip (HC), arm (AC) and Calf (CC) and four skin fold thickness (biceps, triceps, sub-scapular and supra-iliac) were taken by female author on each individual using standard anthropometric techniques and tools [5,6]. Height and weight were measured to the nearest 0.5 cm and 0.1 kg respectively. Body mass index (BMI) was calculated for an estimate of overall adiposity using the formula: BMI = weight (kg)/height (m^2). Waist and Hip circumference (WC and HC) for an estimate of central obesity [7] were measured to the nearest 0.5 cm with a steel tape. Waist to hip ratio (WHR) was calculated using the standard formula: WHR = WC (cm)/HC (cm). A Lange skinfold calliper was used to measure the skinfolds to the nearest 0.2 mm. Two subsequent measurements were taken and averages were used in the analysis.

2.2. Physiometric Measurements

Left arm blood pressures (first phase systolic and fifth phase diastolic) were taken from each participant with standard mercury sphygmomanometer after a 5 min rest. The average of the two subsequent measurements was used for analysis. All efforts were made to minimize the factors which affect the blood pressure like anxiety, fear, stress, laughing and recent activity [8]. Mean arterial blood pressure (MBP) was calculated for each of the two readings taken for SBP and DBP by using the formula: MBP = SBP + (SBP-DBP)/3 [9]. The radial artery at the wrist was used to count the pulse. It was counted over one minute. The difference of SBP and DBP was used as pulse pressure.

3. STATISTICAL ANALYSIS

Descriptive statistics such as means, standard deviations and coefficient of skewness were calculated for all variables. All statistical analysis including factor analyses were conducted by SPSS (Statistical Package for Social Sciences, version 17.0, SPSS Inc. USA). Each of the anthropometric and physiometric variables is highly inter-correlated with each others and creates a methodological problem for analysis the data. PCFA is used when variables are highly correlated and this multivariate statistical tool able to reduce a large number of inter-correlated variables to a smaller number of principal components which account for most of the variance in the data [10,11]. Factor analysis has done on the basis of correlation matrix which helps to understand the amount of association between the variables, factor extraction and orthogonal rotation to make factors easily interpretable. Hence, PCFA was used to extract uncorrelated factors and varimax rotation, which is an orthogonal rotation in which the factors are assumed to act independently, was used in the present study. Factor loadings were equivalent to the correlation coefficients between the variables (rows) and factors (columns). The final factors pattern was interpreted using factor loadings of ≥ 0.4. Extracted factors or number of factors to be retained was based on eigenvalue criteria ≥ 1.0. Eigenvalues indicate the amount of variance explained by each factor. A factor with low eigenvalue has a little contribution to explain the variances in the variables and may be ignored. The first and second principal components were identified through largest and second largest amount of variance in the data and so on. Communality is the squared multiple correlation for the variable (as dependent) using as predictors. Hence, the communality estimates is the measure the percent of variance in a given variable explained by all factors. A communality of 0.75 and 0.25 considered large and low respectively. Low communality indicates variables are negligibly related to each other. The probability values less than or equal to 0.05 (two-tailed) were considered to be significant.

4. RESULTS

Table 1 presents the mean, standard deviation (SD) and skewness of anthropometric and physiometric variables. All right skewed distributions have converted to a normal distribution by square root transformation whereas; reciprocal transformation is used for left skewed distribution among type 2 diabetic males, pre- and post-menopausal females. The highest mean age for onset of T2DM was found among post-menopausal females (52.46 ± 6.22years) and the lowest mean age for the onset of disease was found among pre-menopausal females (36.97 ± 5.96 years) as compared to males (45.19 ± 7.79 years). The other highest mean values of important anthropometric indicator such as BMI, hip circumference, biceps skinfold, triceps skinfold and arm circumference were found among diabetic post-menopausal females as compared to males and pre-menopausal females. The diabetic males have higher mean values for WHR and waist circumference. The physiometric variables such as SBP, DBP, pulse rate and pulse pressure have not shown any specific trend among three groups of diabetic subjects. Bivariate correlations of the traits were examined among type 2 diabetic males, pre- and post-menopausal females and are presented in **Tables 2** to **4**. Waist circumference, hip circumference, biceps skinfold, triceps skinfold, arm circumference and calf circumference with Weight and BMI; hip circumference, biceps skinfold, triceps skinfold, arm circumference and calf circumference with waist circumference have been found signifi-

Table 1. Descriptive Statistics of Anthropometric and Physiometric variables among type 2 diabetic male, pre- and post-menopausal females in the present study population (n = 349).

VARIABLES	MALE (N = 157)			FEMALE (N = 192)					
				PRE-MENOPAUSAL (N = 88)			POST-MENOPAUSAL (N = 104)		
	MEAN	SD	SKEW-NESS	MEAN	SD	SKEWNESS	MEAN	SD	SKEW-NESS
Age (yrs)	53.994	8.093	0.466	46.89	7.85	−0.009	58.39	7.49	0.45
Onset age (yrs)	45.197	7.792	0.836	36.97	5.96	−0.28	52.46	6.22	1.02
Height (cm)	169.131	8.582	−5.437	154.95	5.599	0.19	155.80	6.95	1.57
Weight (Kg)	76.697	6.976	0.533	63.52	7.55	0.36	67.70	8.20	0.43
BMI(kg/m^2)	26.555	3.870	0.370	26.25	3.34	0.21	28.00	5.60	0.62
WHR	0.941	0.0732	0.586	0.88	0.07	0.75	0.87	0.07	−0.17
Waist circumference(cm)	96.014	8.512	0.267	87.23	9.90	0.597	90.26	9.32	0.49
Hip circumference (cm)	101.94	9.056	0.242	99.18	9.59	0.68	103.07	10.97	0.52
Biceps skinfold (mm)	10.806	5.968	1.745	13.11	5.05	0.395	13.26	5.58	1.03
Triceps Skinfold (mm)	14.005	5.053	3.201	17.12	5.19	0.299	17.54	6.76	0.58
Subscapular skinfold (mm)	-------	-------	--------	24.94	4.88	−0.39	26.66	5.399	0.04
Supra-iliac skinfold (mm)	-------	--------	--------	21.37	3.82	−0.14	24.37	4.43	0.10
Arm Circumference (cm)	27.838	3.192	0.282	27.27	3.39	0.18	28.20	3.90	0.87
Calf circumference (cm)	33.548	3.868	0.502	31.97	3.62	0.24	32.34	3.67	0.04
Systolic blood pressure (mmHg)	124.656	9.266	1.802	121.72	8.82	0.86	124.95	9.49	0.798
Diastolic blood pressure (mmHg)	80.083	10.475	1.090	79.55	9.93	−0.12	79.70	9.81	1.04
Mean Blood Pressure (mmHg)	95.924	9.384	2.081	93.56	9.67	0.57	96.14	8.27	2.695
Pulse Rate	83.229	8.471	0.251	85.10	8.85	0.12	83.98	8.24	0.15
Pulse Pressure	44.790	7.232	1.660	42.27	7.58	0.77	46.41	7.08	1.296

Significant at least at $p \leq 0.05$
SD = Standard Deviation

cantly associated at least 5% level ($p < 0.05$) among all diabetic males, pre- and post-menopausal females. SBP and DBP were found to be significantly associated with weight, BMI, waist circumference, hip circumference, biceps skinfold and triceps skinfold at least 5% level ($p < 0.05$) among diabetic pre- and post-menopausal females. Whereas, WHR was found significantly associated ($p < 0.05$) with other anthropometric variables among only type 2 diabetic males.

The comparison of factor loading pattern of six factors (components) is presented in **Table 5** among diabetic males, pre- and post-menopausal females. Only variables with factor loading greater than or equal to 0.4 were considered for present interpretation among three groups. After Varimax rotation, weight, BMI, waist circumference, hip circumference, arm and calf circumferences are relatively large and positively loaded (> 0.7) on factor 1 among males, pre- and post-menopausal females. However, on factor 1 highest loading was found in weight (0.944) for males, hip circumference (0.883) for pre-menopausal females and BMI (0.940) for post-menopausal females. The physiometric variables such as SBP, DBP and pulse pressure are grouped together and loaded positively on factor 2 among three groups. Maximum loading has found for SBP (> 0.90) on factor 2 for all three groups, whereas loading of DBP for this factor is just above the cut-off value (0.4) for post-menopausal females. Both mean age (actual age and onset age of type 2 diabetes) have found maximum loading (0.952 and 0.940) on factor 3 among males, whereas, skinfold thickness (biceps, triceps, sub-scapular and supra-iliac) grouped together and loaded significantly among pre- and post-menopausal females. Only triceps skinfold and biceps skinfold among males have positive loading on factor 4, whereas, actual mean age and the mean age of onset of the disease have grouped for higher positive loading among pre- and post-menopausal females. Only WHR has positive loading on factor 5 among males, whereas, WHR and waist circumference for pre-menopausal females and WHR, height and waist circumference for post-menopausal females have positive loading on this factor. However WHR has maximum positive loading (≥ 0.80) among pre- and post-menopausal females but for males it is just above cut-off value (0.55). Only Height and pulse rate have positive loading on factor 6 among pre- and post-menopausal female whereas, all variables are extracted on this factor among males. The five factors explained 79% of the total variance among males in which the first two factors cumulatively explained 54% of the total variance. Whereas, the six factors explained 78% of the total variance among pre- and post-menopausal females in which first two factors cumulatively explained 48% and 49% of the total variance respectively. The eigenvalue of the first two factors have also been seen maximum among males, pre- and post-menopausal females. The

Table 2. Inter-correlation matrix of selected anthropometric variables among males of Type 2 Diabetes Mellitus (T2DM).

VARIABLES	Age (yrs)	OA (yrs)	Ht (cm)	Wt (Kg)	BMI (kg/m^2)	WHR	WC (cm)	HC (cm)	BSkn (mm)	T Skn (mm)	AC (cm)	CC (cm)	SBP (mmHg)	DBP (mmHg)	MBP (mmHg)	PR	PP
Age (yrs)		.81*	−.05	−.06	−.007	.03	.05	.03	−.003	−.08	−.04	−.09	−.05	−.05	−.10	−.12	.02
Onset age (yrs)			−.03	.09	.16	.09	.17	.16	.09	.01	.10	.04	−.08	−.005	−0.12	−.13	−.06
Height (cm)				.09	−.15	−.12	−.06	−.007	−.17	−.27	−.02	−.03	−.007	−.07	−0.04	−.04	.03
Weight (Kg)					.91*	.48*	.87*	.84*	.58*	.40*	.73*	.73*	.08	.18	0.11	−.11	.05
BMI(kg/m^2)						.50*	.85*	.80*	.57*	.46*	.73*	.73*	.07	.18	0.11	−.12	.03
WHR							.68*	.20*	.33*	.40*	.42*	.34*	.03	.12	0.04	−.19	−.001
Waist circumference (cm)								.82*	.62*	.45*	.75*	.70*	.01	.13	0.05	−.20*	−.004
Hip circumference (cm)									.60*	.32*	.70*	.70*	−.006	.09	0.05	−.09	−.009
Biceps skinfold (mm)										.72*	.64*	.50*	.003	.07	−0.02	−.13	.011
Triceps Skinfold (mm)											.46*	.32*	−.04	.04	−0.04	−.13	−.03
Arm Circumference (cm)												.68*	.03	.13	0.06	−.13	−.005
Calf circumference (cm)													.001	.04	0.01	−.10	−.001
Systolic blood pressure (mmHg)														.73	0.86*	.08	.90*
Diastolic blood pressure (mmHg)															0.80*	−.004	.40*
Mean Blood Pressure (mmHg)																.053	.67*
Pulse Rate																	.09*
Pulse Pressure																	

Significant at least at $p \leq 0.05$; OA = Onset age, yrs = years, Ht = Height, Wt = Weight, BMI = Body Mass Index, WHR = Waist Hip Ratio, WC = Waist Circumference, HC = Hip Circumference, BS = Biceps skinfold, TS = Triceps skinfold, SS = Sub-scapular skinfold, SiS = Supra-iliac skinfold, AC = Arm Circumference, CC = Calf Circumference, SBP = Systolic Blood Pressure, DBP = Diastollic Blood Pressure, MBP = Mean Blood Pressure, PR = Pulse Rate, PP = Pulse Pressure.

common greater communality estimates (> 0.70) have found on age, onset age of disease, weight, BMI, waist circumference, hip circumference, triceps skinfold, SBP among three groups. WHR has maximum communality estimates among pre- and post-menopausal females.

5. DISCUSSION

The present quantitative analysis have shown that which of the anthropometric and physiometric traits (BMI, WHR, weight, waist circumference, hip circumference, skinfolds, SBP, DBP, and pulse pressure) are more closely associated and act as a good predictors for further risk among three groups of T2DM individuals such as males, pre- and post-menopausal females in North Indian Punjabi population. The present study also provides through PCFA among three groups that which of the traits would require more attention to clinicians for raised risk of T2DM.

The many previous studies suggested that obesity, overweight, glucose intolerance, hypertension and elevated blood pressures are closely associated with T2DM [12-18].The present analysis showed a common association of BMI, WHR, waist circumference, hip circumference and subcutaneous fat with T2DM incidence among males, pre-and post-menopausal females.

Table 3. Inter-correlation matrix of selected variables among pre-menopausal females of Type 2 Diabetes Mellitus (T2DM).

VARIABLES	Age (yrs)	OA (yrs)	Ht (cm)	Wt (Kg)	BMI (kg/m^2)	WHR	WC (cm)	HC (cm)	BSkn (mm)	T Skn (mm)	SS (mm)	SiS (mm)	AC (cm)	CC (cm)	SBP (mmHg)	DBP (mmHg)	MBP (mmHg)	PR	PP
Age (yrs)		.54*	−.08	−.05	−.14	.10	.08	.03	.05	.07	.06	.04	−.09	−.14	.13	−.04	.02	−.06	.22
OA (yrs)			−.03	−.03	−.06	−.05	−.03	.02	−.02	.08	−.006	.19	−.04	.06	.17	.10	.10	.05	.19
Ht (cm)				.30	−.08	.10	.06	.0097	.013	.04	.16	.06	.15	.09	.02	.03	.03	.22	.006
Wt (Kg)					.83*	.15	.80*	.82*	.53*	.42	.36*	.50*	.70*	.51*	.17	.11	.19	−.06	.13
BMI(kg/m^2)						.08	.68*	.73*	.58*	.45	.34*	.43*	.68*	.61*	.16	.09	.18	−.13	.15
WHR							.51*	−.16	.009	−.12	.10	.14	−.03	−.02	−.05	−.02	.007	.04	−.08
WC(cm)								.75*	.48*	.30*	.22*	.42*	.58*	.46*	.18	.20*	.24*	−.08	.08
HC (cm)									.56*	.45*	.21*	.40*	.69*	.53*	.24*	.24*	.28*	−.14	.14
BS (mm)										.80*	.45*	.46*	.66*	.49*	.15	.03	.099	−.30*	.19
T S (mm)											.38*	.36*	.54*	.38*	.13	−.07	.04	−.25*	.25
SS (mm)												.66*	.24*	.16	−.05	−.05	−.06	−.19	−.03
SiS (mm)													.35*	.31*	.12	.09	.10	−.05	.10
AC (cm)														.66*	.008	−.03	.03	−.13	.02
CC (cm)															.008	.04	.05	−.14	−.008
SBP (mmHg)																.71*	.91*	−.09	.87*
DBP (mmHg)																	.85*	.09	.29*
MBP (mmHg)																		−.009	.65*
P R																			−.17
P P																			

Significant at least at $p \leq 0.05$; OA = Onset age, yrs = years, Ht = Height, Wt = Weight, BMI = Body Mass Index, WHR = Waist Hip Ratio, WC = Waist Circumference, HC = Hip Circumference, BS = Biceps skinfold, TS = Triceps skinfold, SS = Sub-scapular skinfold, SiS = Supra-iliac skinfold, AC = Arm Circumference, CC = Calf Circumference, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, MBP = Mean Blood Pressure, PR = Pulse Rate, PP = Pulse Pressure.

Table 4. Inter-correlation matrix of variables among post-menopausal females of Type 2 Diabetes Mellitus (T2DM).

VARIABLES	Age (yrs)	OA (yrs)	Ht (cm)	Wt (Kg)	BMI (kg/m^2)	WHR	WC (cm)	HC (cm)	BSkn (mm)	T Skn (mm)	SS (mm)	SiS (mm)	AC (cm)	CC (cm)	SBP (mmHg)	DBP (mmHg)	MBP (mmHg)	PR	PP
Age (yrs)		.73*	−.12	.007	.06	−.01	.17	.15	−.08	−.02	−.20*	−.07	−.04	.03	.06	−.07	.14	.15	.09
OA (yrs)			−.08	−.03	.006	.04	.07	.03	−.04	.04	−.09	−.05	−.08	−.02	.06	.099	.16	.15	.005
Ht (cm)				.19	−.23*	.17	.06	−.05	.04	.10	.03	−.08	−.09	−.02	−.15	−.07	−.11	−.03	−.19
Wt (Kg)					.90*	.18	.80*	.83*	.53*	.40*	.54*	.52*	.76*	.74*	.13	.18	.10	.05	−.005
BMI(kg/m^2)						.07	.77*	.85*	.50*	.35*	.52*	.55*	.80*	.74*	.20	.20*	.16	.08	.09
WHR							.47*	−.08	.10	.10	.10	.03	.01	−.02	.002	−.09	.10	−.03	.05
WC(cm)								.796*	.53*	.42*	.495*	.46*	.65*	.62*	.19	.083	.20	.10	.15
HC (cm)									.50*	1.0	.55*	.53*	.77*	.75*	.16	.12	.14	.05	.09
BS (mm)										.78*	.50*	.47*	.44*	.44*	.06	.05	.009	.013	.06
T S (mm)											.44*	.37*	.33*	.33*	.03	−.05	.01	.013	.10
SS (mm)												.60*	.49*	.43*	−.09	−.02	−.15	−.002	−.12
SiS (mm)													.48*	.49*	.18	.12	.03	−.03	.12
AC (cm)														.69*	.12	.21*	.12	.05	.007
CC (cm)															.20*	.16	.12	.06	.14
SBP (mmHg)																.59*	.72*	.13	.86*
DBP (mmHg)																	.56*	.13	.16
MBP (mmHg)																		.003	.53*
PR																			.06
PP																			

Significant at least at $p \leq 0.05$; OA = Onset age, yrs = years, Ht = Height, Wt = Weight, BMI = Body Mass Index, WHR = Waist Hip Ratio, WC = Waist Circumference, HC = Hip Circumference, BS = Biceps skinfold, TS = Triceps skinfold, SS = Sub-scapular skinfold, SiS = Supra-iliac skinfold, AC = Arm Circumference, CC = Calf Circumference, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, MBP = Mean Blood Pressure, PR = Pulse Rate, PP = Pulse Pressure.

Table 5. Comparison of factor loadings by principal component analysis with Varimax rotation and communalities of the risk factors among type 2 diabetic male, pre-menopausal and post-menopausal females (n = 349).

VARIABLES	FACTOR 1			FACTOR 2			FACTOR 3			FACTOR 4			FACTOR 5			FACTOR 6			COMMU-NALITY ESTIMATES		
	M	PRF	POF	M	PRF	POF	M	PRF	POF	M	PRF	POF	M	PRF	POF	M	PRF	POF	M	PRF	POF
Age (yrs)	−.046	−.083	.042	−.025	.038	.041	.952	.057	−.072	.008	.860	.930	.053	.136	−.021	----	−.134	.010	.912	.787	.874
Onset age (yrs)	.114	.013	−.035	−.054	.105	.048	.940	.021	.021	.015	.868	.873	.054	−.097	.006	----	.111	.168	.902	.787	.794
Height (cm)	.056	.041	−.099	−.035	.030	−.217	−.080	.303	.104	−.827	−.084	−.196	.118	.007	.652	----	.726	.404	.709	.629	.695
Weight (Kg)	.944	.833	.903	.091	.117	.017	−.147	.260	.160	−.043	−.042	−.029	.102	.255	.241	----	.173	.129	.912	.872	.917
BMI(kg/m^2)	.905	.841	.940	.088	.101	.112	.054	.171	.111	.154	−.108	.054	.083	.154	−.057	----	−.118	−.026	.861	.796	.916
WHR	.432	−.029	.072	.061	−.060	.092	.007	.107	.034	.278	.025	.080	.550	.913	.831	----	.006	−.296	.569	.849	.799
Waist circumference(cm)	.900	.735	.796	.033	.133	.139	.078	.087	.215	.117	.039	.182	.253	.620	.412	----	−.030	−.072	.894	.953	.908
Hip circumference (cm)	.911	.883	.903	.002	.202	.048	.088	.060	.184	−.031	.039	.103	−.088	.019	−.064	----	−.037	.027	.846	.827	.867
Biceps skinfold (mm)	.663	.633	.419	−.020	.067	.025	−.002	.527	.794	.473	.043	−.046	.106	−.125	.064	----	−.271	.045	.675	.775	.814
Triceps Skinfold (mm)	.429	.511	.245	−.051	.033	.021	−.110	.540	.880	.680	.114	.045	.245	−.267	.103	----	−.257	.036	.722	.704	.848
Subscapular skinfold (mm)	--	.137	.571	--	−.071	−.197	--	.871	.469	---	−.030	−.179	--	.103	.005	----	.032	−.037	----	.795	.619
Supra-iliac skinfold (mm)	--	.346	.577	--	.079	.091	--	.684	.413	---	.125	−.104	--	.202	−.143	----	.105	−.107	-----	.661	.554
Arm Circumference (cm)	.838	.863	.871	.030	−.071	.037	−.006	.175	.077	.115	−.041	−.078	.113	−.096	−.053	----	.014	.070	.729	.792	.780
Calf circumference (cm)	.837	.763	.811	−.025	−.046	.103	−.062	.048	.141	−.011	−.021	−.006	.002	−.135	−.053	----	.031	.057	.705	.606	.694
Systolic blood pressure (mmHg)	.006	.056	.102	.970	.975	.957	−.028	.050	.031	−.013	.103	−.002	.036	−.034	−.057	----	−.066	.101	.944	.972	.941
Diastolic blood pressure (mmHg)	.097	.076	.190	.823	.817	.579	−.009	−.117	−.163	.061	−.063	−.135	.086	.082	−.084	----	.178	.539	.698	.729	.714
Mean Blood Pressure (mmHg)	.035	.104	.102	.934	.965	.833	−.082	−.043	−.115	−.007	−.014	.103	−.003	.046	.112	----	.046	.108	.880	.948	.752
Pulse Rate	−.049	−.084	.028	.060	−.032	.035	−.097	−.254	.062	.088	.065	.235	−.862	−.005	−.059	----	.752	.642	.769	.642	.477
Pulse Pressure	.007	.015	−.032	.814	.767	.846	.020	.165	.178	−.029	.207	.066	−.084	−040	−.060	----	−.209	−.215	.671	.721	.802
Eigenvalue	6.016	5.917	6.408	3.190	3.159	2.876	1.837	1.762	1.804	1.318	1.574	1.444	1.034	1.228	1.201	---	1.204	1.034	---	---	---
Variance Explained(%)	35.389	31.140	33.726	18.767	16.626	15.135	10.806	9.274	9.496	7.756	8.286	7.601	6.084	6.464	6.322	---	6.336	5.440	----	---	----
Cumulative Variance(%)	35.389	31.140	33.726	54.157	47.767	48.860	64.962	57.041	58.356	72.718	65.327	65.957	78.801	71.791	72.28	---	78.127	77.719	---	---	---

Factor Loadings ≥ 0.4; M = Males, PMF = Pre-menopausal females, POF = Post-menopausal females.

PCFA is applied to identify the significant association with T2DM among three groups. As far as concern in the North Indian Punjabi population, very little information [15,19-21] to identify the underlying factors/components of the T2DM are available. In this consideration the present work has been undertaken among the males and females (pre- and post-menopausal). PCFA have identified five factors with 79% explained variance among male diabetic subjects and six factors with 78% explained variance among pre- and post-menopausal diabetic female subjects.

It is important to note that neither of the anthropometric and physiometric variables equally loaded on all five or six components. Factor 1 is the most diverse among three groups. It could be identified as weight, BMI, waist circumference for males; hip circumference, BMI, weight for pre-menopausal females and BMI, weight, hip circumference for post-menopausal females. However weight for males, hip circumference for pre-menopausal and BMI for post- menopausal females are heavily loaded. The second factor could be identified as SBP and DBP for males and pre-menopausal females and DBP for post-menopausal females. This component is most clearly and heavily loaded. Therefore, among diabetic individuals, males and pre-menopausal females were very closely associated with SBP and DBP whereas, post-menopausal diabetic females were more concerned with DBP only. Among male diabetic subjects factor three was grouped with actual age and age of onset of the disease, whereas, subcutaneous fat was identified as factor three. Factor four could be identified as subcutaneous fat for males, whereas actual age and age of onset of the disease were grouped together for factor four.

Factor five could be identified as WHR for the three groups. However, WHR is heavily loaded for pre- and post-menopausal females. Pulse rate could be identified as factor six for both pre- and post-menopausal females, whereas, no sixth factor is identified for males.

The present factor analysis confirmed that cluster of at least three variables such as, weight, BMI, waist circumference which have identified as factor one explained 35%, 31% and 34% of the total variance among diabetic males, pre- and post-menopausal females respectively. Therefore, the cluster of weight, BMI and waist circumference could be classified as central obesity and this cluster is equally associated with diabetic males and post-menopausal females. Furthermore, in the present study, the second factor, that is blood pressures explained 19%, 17% and 15% of the total variance among diabetic males, pre- and post-menopausal females. The blood pressures (SBP and DBP) were positively and significantly associated with diabetic males. Therefore the above two types factors such as, central obesity and blood pressures are more predispose among diabetic males as compared to females. PCFA also confirmed that WHR and pulse pressure are significantly

associated with diabetic pre- and post-menopausal females as compared to diabetic males. Therefore, it is very difficult to single out of the particular variable which is more associated with male or pre- and post-menopausal females due to the fact that many overlapping variables have found as more than one factor among all the three groups. Further, research with PCFA is required on other Indian ethnic groups to compare the present trend of the study.

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