CHAPTER 7		
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7.0 RESULTS

7.1 CORRELATION STUDY FBS AND EPI PARAMETERS

There were total of 7 organs considered for the study. The data for these came from the module 'EPI screening'. The 7 organs/ systems are liver, pancreas, immune organs, coronary vessels, cerebral vessels, left kidney and right kidney. The average value of parameters associated with these organs in the three groups is given in (Table 3). These organs / systems were selected based on literature on diabetes from the modern medical system. These organs are prone to changes from inception to the advanced stages of diabetes. The average of integral area of the left and right fingers was taken for the study. There were total of 5 general parameters which are related to the image of the fingers. These are area, entropy, fractality, form coefficient and intensity. The data for these came from the module 'EPI scientific laboratory' (Table 4). The participants were divided into three groups; a) Normal, b) pre diabetes and c) diabetes. First, correlation analysis (Table 5) was applied followed by linear regression analysis. In Normal, a high correlation (but not significant) between FBS and form coefficient ($p=0.06$ $r=0.35$) was observed (Table 6). Significant correlation was found between FBS and right kidney ($p=.03$ $r=-0.60$) in pre diabetic group (Table 7). In the case of diabetics, a high correlation (but not significant) was observed of FBS with immune organs ($p=0.06$ $r=-0.25$), with coronary vessels ($p=0.09$ $r=0.22$) and with entropy ($p=0.08$ $r=0.23$) (Table 8). Negative sign indicates that predictor variable and responding variable increase in opposite directions.

Table 3: EPI Diagram / Screening Analysis. Independent sample‘t’ test

Variables	Normal Mean ±SD	Pre diabetic Mean ±SD	Diabetic Mean ±SD
Av. Liver	-0.05±0.47	0.10±0.33	0.27±0.53
Av. Immune organs	-0.20±0.31	-0.17±0.29	0.08±0.38
Av. Pancreas	-0.26±0.59	0.10±0.39	0.22±0.53
Av. Coronary vessels	-0.13±0.37	-0.05±0.24	0.21±0.32
Av. Cerebral vessels	-0.02±0.29	0.01±0.31	0.26±0.35
Av. Left Kidney	-0.05±0.44	0.05±0.39	0.26±0.43
Av. Right Kidney	-0.09±0.36	-0.06±0.38	0.24±0.46

Table 4: EPI Scientific Laboratory Analysis. Independent sample‘t’ test

Variables	Normal Mean ±SD	Pre diabetic Mean ±SD	Diabetic Mean ±SD
Av. Area	11487.62±1416.98	11597.54±1425.695	12003.11±1451.19
Av. Intensity	78.0867±5.863	77.3890±8.345	84.06±7.62
Av. Form Coefficient	14.9347±4.792	15.5009±6.065	11.34±3.24
Av. Entropy	1.8603±0.161	1.7691±0.180	1.96±0.16
Av. Fractility	1.9229±0.174	1.9860±0.120	1.85±0.05

Table 5: Correlation Analysis (all parameters)

	FBS/with	t	df	p	r
Normal	Av. Liver	0.966	27	0.342	0.182
	Av. Immune organs	1.392	27	0.175	0.258
	Av. Pancreas	0.047	27	0.962	0.009
	Av. Coronary vessels	0.995	27	0.328	0.188
	Av. Cerebral vessels	-0.157	27	0.875	-0.030
	Av. Lt Kidney	0.832	27	0.412	0.158
	Av. Rt Kidney	0.553	27	0.584	0.105
	Av.Total Area	1.454	27	0.157	0.269
	Av. Intensity	-0.718	27	0.478	- 0.136
	Av.Form Coeff	1.943	27	0.062	0.350
	Av.Entropy	0.066	27	0.947	0.012
	Av.Fractility	-0.179	27	0.858	-0.034

Pre diabetic	Av. Liver	-1.203	11	0.254	-0.341
	Av. Immune organs	-0.555	11	0.589	-0.165
	Av. Pancreas	0.800	11	0.440	0.234
	Av. Coronary vessels	0.921	11	0.376	0.267
	Av. Cerebral vessels	0.006	11	0.994	0.002
	Av. Lt Kidney	0.299	11	0.770	0.089
	Av. Rt Kidney	-2.459	11	0.031	-0.595
	Av.Total Area	0.182	11	0.858	0.055
	Av. Intensity	1.035	11	0.322	0.298
	Av.Form Coeff	-0.251	11	0.805	-0.075
	Av.Entropy	1.193	11	0.257	0.338
	Av.Fractility	-0.773	11	0.453	-0.227
Diabetic	Av. Liver	-0.742	58	0.461	-0.096
	Av. Immune	-1.956	58	0.055	-0.248

	organs				
	Av. Pancreas	-0.578	58	0.565	-0.075
	Av. Coronary vessels	-1.752	58	0.085	-0.224
	Av. Cerebral vessels	-0.656	58	0.514	-0.085
	Av. Lt Kidney	- 0.749	58	0.456	-0.097
	Av. Rt Kidney	-0.979	58	0.331	-0.127
	Av.Total Area	0.935	58	0.353	0.121
	Av. Intensity	-1.647	58	0.104	-0.211
	Av.Form Coeff	0.960	58	0.340	0.125
	Av.Entropy	-1.771	58	0.081	0.208
	Av.Fractility	1.621	58	0.110	-0.226

df- degrees of freedom are the number of values in a study that have the freedom to vary. r-the main result of a correlation is called the correlation coefficient. It ranges from -1.0 to +1.0. The closer **r** is to +1 or -1, the more closely the two variables are related. If **r** is close to 0, it **means** there is no relationship between the variables.

Table 6: Noteworthy Correlation matrix for normal

FBS/with	t	df	P	r
Form Coefficient	1.9434	27	0.0624	0.3503

t –'t' test, df –degrees of freedom, p –level of significance <0.05 considered significant

r –correlation coefficient varies between -1 to +1

Table 7: Noteworthy Correlation matrix for pre-diabetic

FBS/with	t	df	P	r
Right Kidney	-2.4598	11	0.0316	-0.5957

t –'t' test, df –degrees of freedom, p –level of significance <0.05 considered significant

r –correlation coefficient varies between -1 to +1

Table 8: Noteworthy Correlation matrix for diabetic

FBS/with	t	df	P	r
Immunity	-1.9563	58	0.0552	-0.2487
Coronary	-1.752	58	0.0850	-0.2241
Entropy	-1.7717	58	0.0817	0.2082

t –'t' test, df –degrees of freedom, p –level of significance <0.05 considered significant

r –correlation coefficient varies between -1 to +1

The results of regression analysis for the three different groups are as follows. Normal (Table 9), Fig 7 represents the graphical scatter plot of FBS vs Area and Form Coefficient. Pre diabetic (Table 10), Fig 8 represents the graphical scatter plot of FBS vs Pancreas and Right Kidney. Diabetic (Table 11), Fig 9 represents the graphical scatter plot of FBS vs Immune organs, Intensity, Left Kidney, Entropy and Area.

Table 9: Regression analysis, Normal

	Estimate	Standard Error	t value	Pr(>|t|)
Intercept	49.475	10.964	4.512	0.000122***
Area	0.0024	0.0008	3.085	0.004780**
Form Coefficient	0.7796	0.2294	3.398	0.002196**
Residual standard error 5.167		Significant codes '***' p<0.001 '**' <0.01		
FBS= $\alpha+ \beta1X1+ \beta2X2+ \epsilon$ Where α=49.475, $\beta1$=0.0024, $\beta2$=0.7796, ϵ=5.167 X1= Total area ; X2= Form coefficient				

α –constant, $\beta1$-coefficient of variable X1, $\beta2$- coefficient of variable X2,

ϵ-residual standard error, p<.001 very highly significant, p<.01highly significant

Figure 7: Scatter plots of Area and Form coefficient w.r.t FBS in normal subjects showing slope of linear regression equation

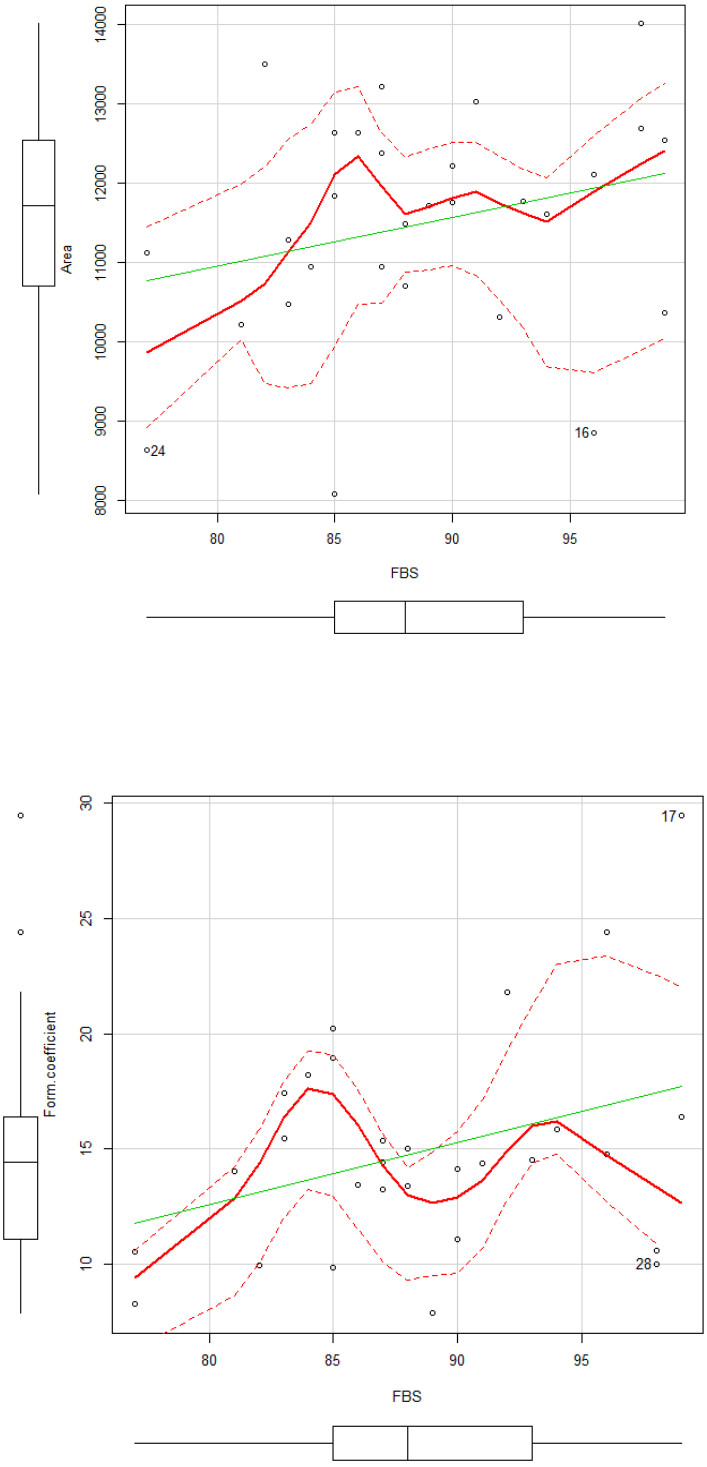


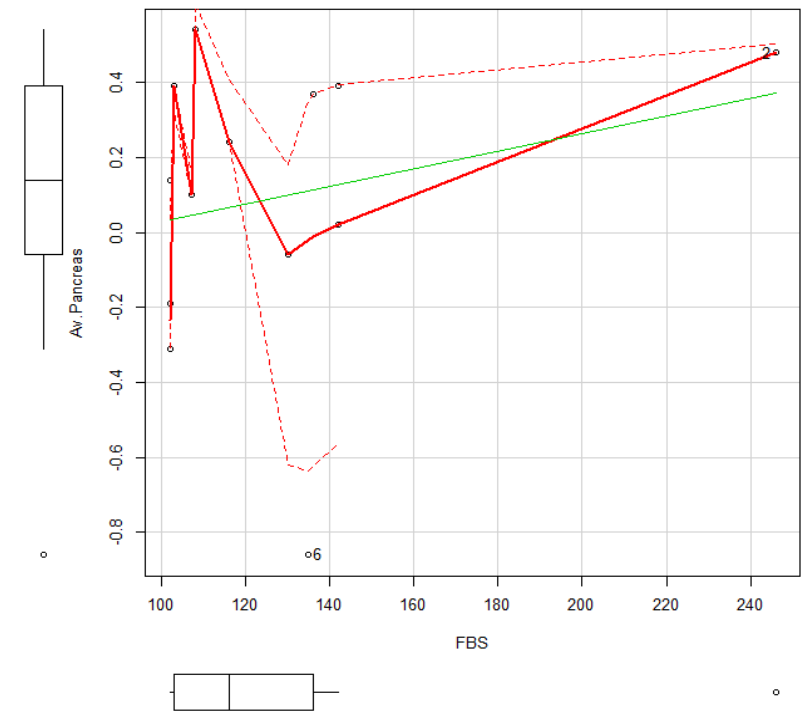
Table 10: regression analysis, Pre diabetic

	Estimate	Standard Error	t value	Pr(>|t|)
Intercept	116.856	7.246	16.126	1.74e-08***
Pancreas	63.734	20.187	3.157	0.01021*
Right Kidney	-90.257	20.572	-4.387	0.00136**
Residual standard error 24.16		Significant codes '***'p< 0.001 '**' p<0.01 '*' p<0.05		
FBS= α+ β1X1+ β2X2+ ϵ Where α=116.856, β1=63.734, β2=-90.257, ϵ=24.16 X1= Integral area of pancreas ; X2= Integral area of right kidney				

α –constant, β1-coefficient of variable X1, β2- coefficient of variable X2, ϵ-residual standard error,

p<.001 very highly significant, p<.01highly significant, p<0.05 significant

Figure 8: Scatter plots (slope) of Pancreas and Right Kidney w.r.t FBS in pre diabetes



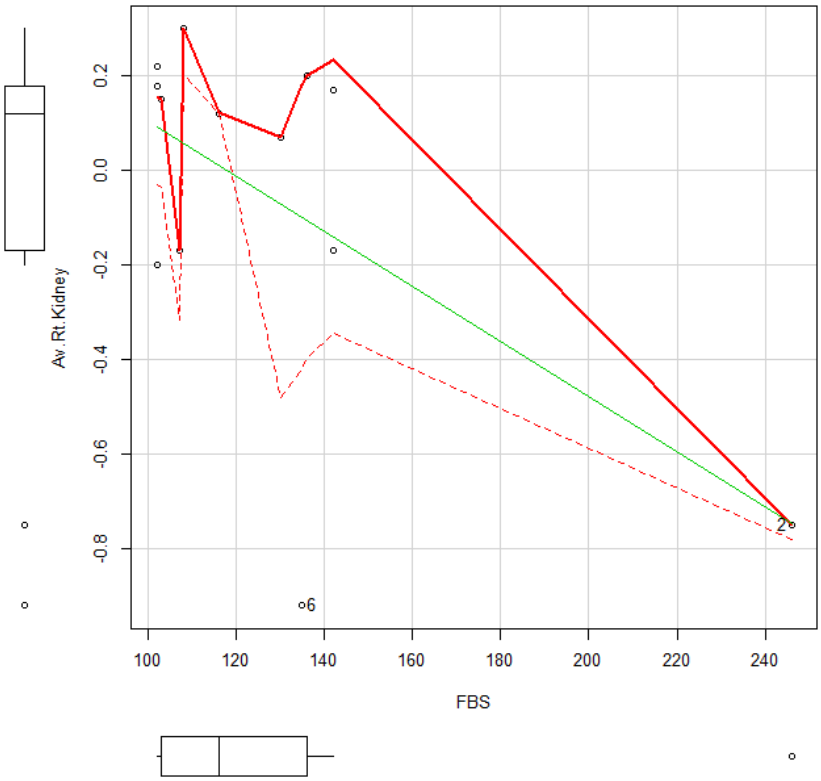


Table 11: regression analysis, Diabetic

	Estimate	Standard Error	t value	Pr(>|t|)
Intercept	494.6	139.4	3.548	0.000812***
Immune organs	-96.11	31.78	-3.024	0.003809**
Intensity	-3.082	1.176	-2.621	0.011356*
Left Kidney	51.33	28.12	1.825	0.073502 '.'
Entropy	-149.3	52.15	-2.863	0.005965**
Area	.017	.006	2.711	0.008983**
Residual standard error 61.42		Significant codes '***' p<0.001 '**' p<0.01 '*' p<0.05 '.' P<.1		

FBS= α+ β1X1+ β2X2+ β3X3+ β4X4 +β5X5+ ϵ

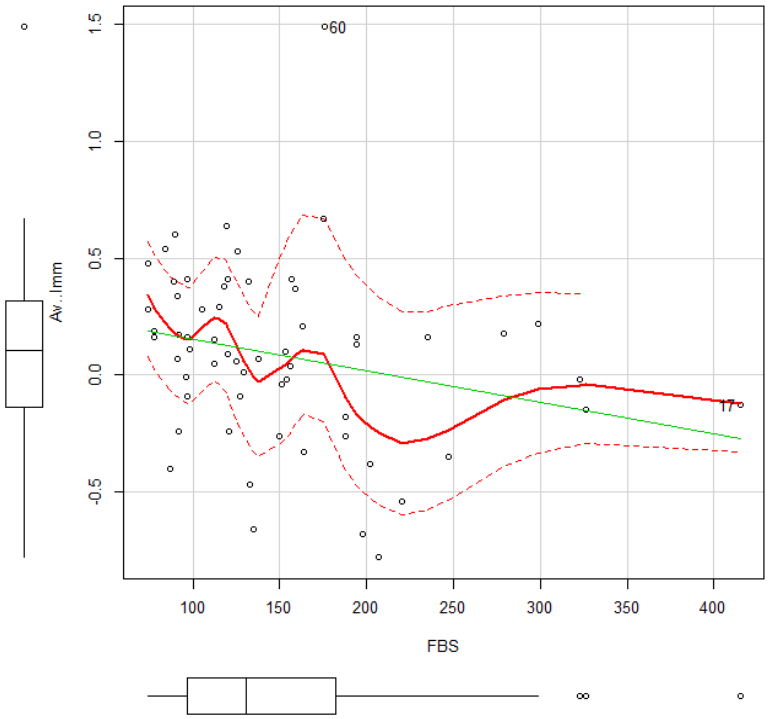
Where α=494.6, β1=-96.11, β2=-3.082, β3=51.33, β4=-149.3, β5=.01698, ϵ=61.42

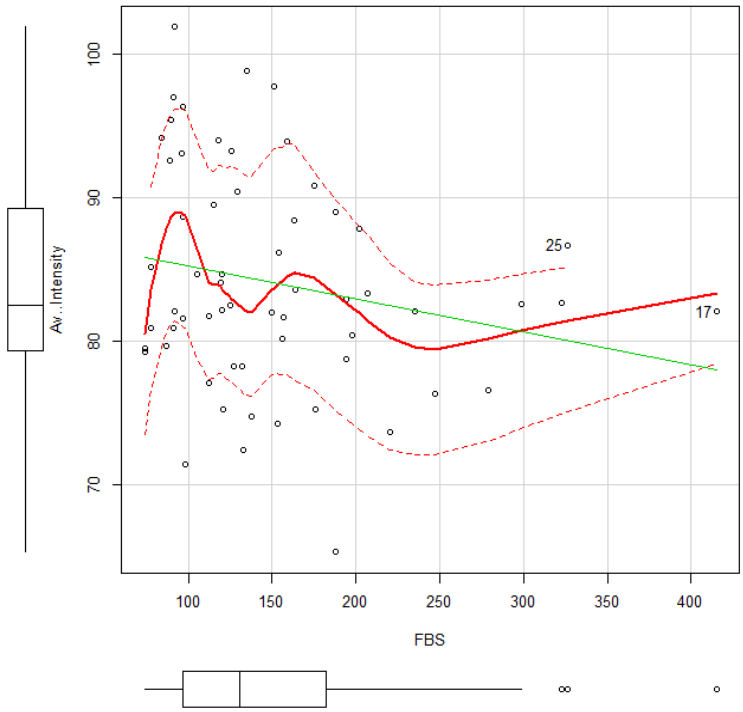
X1= Integral area of immune organs **;** X2= intensity ; X3= Integral area of left kidney ; X4=Entropy; X5=Area

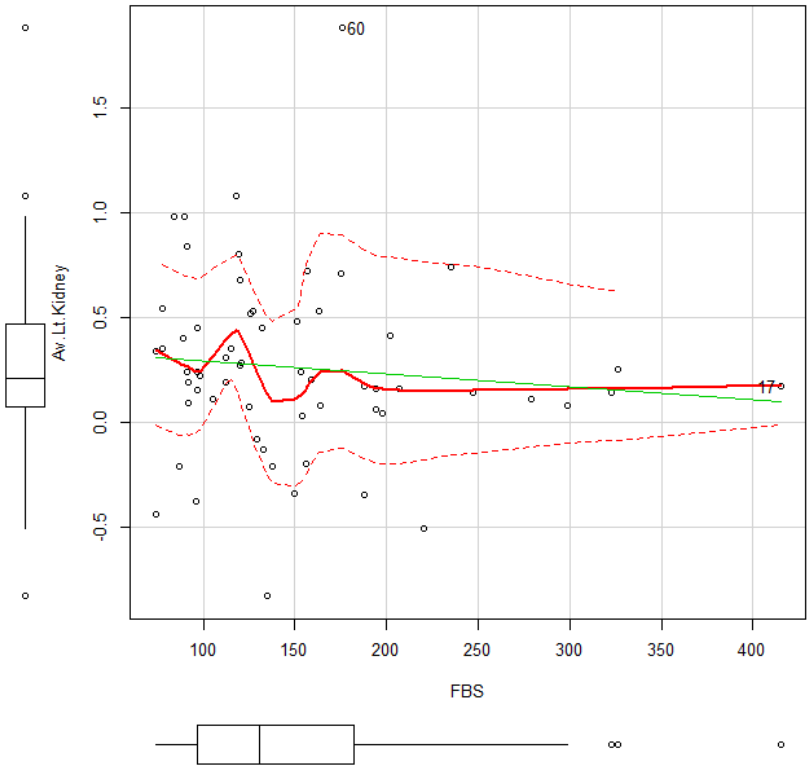
α –constant, β1-coefficient of variable X1, β2- coefficient of variable X2, t- 't' test value

ϵ-residual standard error, p<.001 very highly significant, p<.01highly significant, p<.1 not significant

Figure 9: Slope of Immunity, Intensity, Left Kidney, Entropy and Total area.



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17
Av.Lt.Kidney
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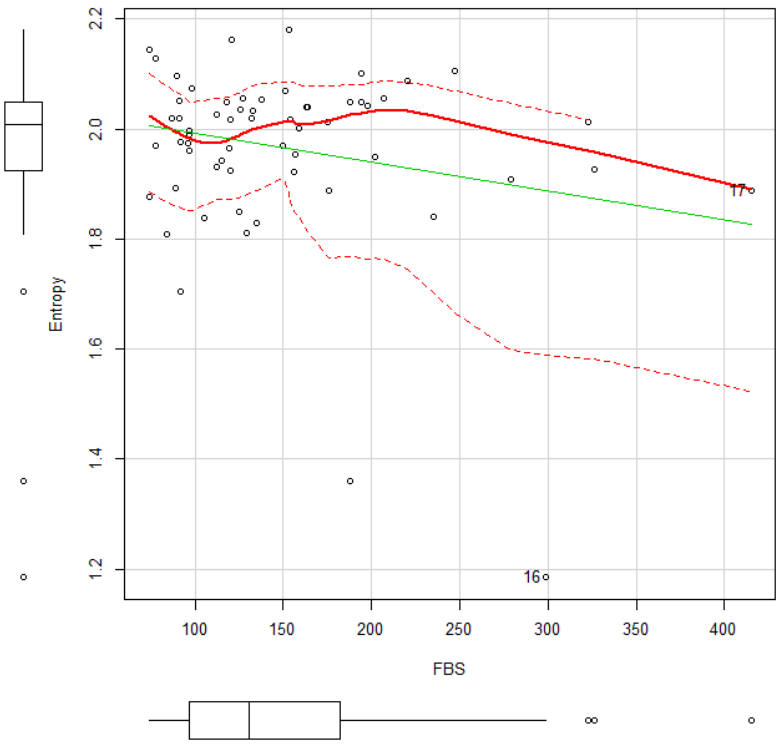
17
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Entropy
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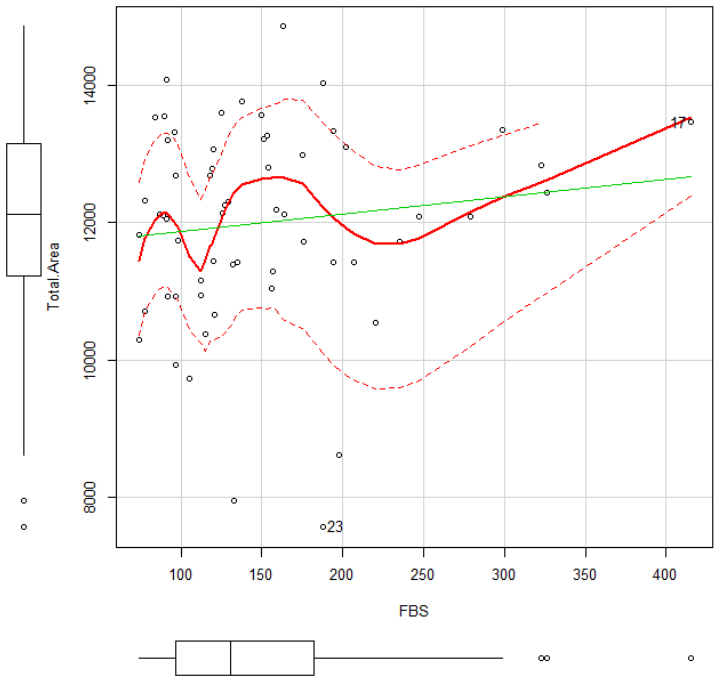

In the diabetic group separate analysis was done for males and females. Correlation and regression analysis are reflected in Tables (12 and 13).

Table 12: Correlation Analysis Diabetic males and females (separately)

Males	FBS/with	t	df	p	r
	Av. Liver	-0.046	33	0.963	-0.008
	Av. Immune organs	-1.627	33	0.113	-0.272
	Av. Pancreas	0.260	33	0.795	0.045
	Av. Coronary vessels	-1.02	33	0.315	-0.174
	Av. Cerebral vessels	-0.656	33	0.514	-0.085
	Av. Lt Kidney	- 0.005	33	0.995	-0.000

	Av. Rt Kidney	-0.203	33	0.840	-0.035
	Av. Area	1.049	33	0.301	0.179
	Av. Intensity	-0.740	33	0.464	-0.127
	Av.Form Coeff	0.355	33	0.724	0.061
	Av.Entropy	-0.944	33	0.351	-0.162
	Av.Fractility	0.888	33	0.380	0.152
Females	Av. Liver	-0.555	23	0.584	-0.114
	Av. Immunity	-0.465	23	0.646	-0.096
	Av. Pancreas	-1.136	23	0.267	-0.230
	Av. Coronary	-0.774	23	0.446	-0.159
	Av. Cerebral	-0.013	23	0.989	-0.002
	Av. Lt Kidney	- 0.477	23	0.635	-0.099
	Av. Rt Kidney	-1.021	23	0.317	-0.208
	Av. Area	0.507	23	0.617	0.105
	Av. Intensity	-1.239	23	0.227	-0.250
	Av.Form Coeff	0.718	23	0.480	0.148
	Av.Entropy	-1.325	23	0.198	0.279
	Av. Fractility	1.394	23	0.176	0.152

Table 13 Regression analysis, Diabetics males and females (separately)

Males	Estimate	Standard Error	t value	p
Intercept	707.686	309.572	2.286	0.03*
Av.Immune organs	-90.095	40.229	-2.240	0.03*
Av.Intensity	-4.156	2.022	-2.055	0.04*
Av.Left Kidney	64.576	39.664	1.628	0.11
Av.Right Kidney	-18.652	33.699	-0.553	0.58
Av.Entropy	-252.386	122.559	-2.059	0.04*
Av.Area	0.023	0.011	2.067	0.04*
Residual standard error 64.05		Significant codes '***' p<0.001 '**' p<0.01 '*' p<0.05 '.' P<.1		
FBS= α+ β1X1+ β2X2+ β3X3+ β4X4 +β5X5+ β6X6+ ϵ Where α=707.6, β1=-90.09, β2=-4.15, β3=64.57, β4=-18.65, β5=-252.38, β6=0.02;ϵ=64.05 X1= Integral area of immune organs **;** X2= intensity ; X3= Integral area of left kidney ; X4= Integral area of right kidney; X5=Entropy; X6=Area				
Females	Estimate	Standard Error	t value	p
Intercept	-1123.12	605.61	-1.855	0.07.
Av. Immune organs	-117.46	67.09	-1.751	0.09.
Av. Left Kidney	80.00	58.34	1.371	0.185
Av. Entropy	-168.03	68.86	-2.440	0.024*

Av. Fractility	864.54	349.14	2.476	0.022*
Residual standard error 61.04		Significant codes '***' p<0.001 '**' p<0.01 '*' p<0.05 '.' P<.1		
FBS= α+ β1X1+ β2X2+ β3X3+ β4X4 + ϵ Where α=-1123.12, β1=-117.46, β2=80.00, β3=-168.03, β4=864.54;ϵ=61.04 X1= Integral area of immune organs; X2= Integral area of left kidney ; X3=Entropy; X4=Fractility				

7.2 CORRELATIONAL STUDY HbA1c AND EPI PARAMETRS

Biochemical parameter HbA1c was compared with EPI parameters namely 1. General parameters: area, entropy, intensity, form coefficient, fractality.2. Organ specific: integral area of liver, pancreas, immune organs, coronary vessels, cerebral vessels, left kidney, right kidney. The organ specific parameters were selected from a large number of parameters which are closely related to diabetes. The subjects were divided into three groups; a) normal, b) pre diabetes and c) diabetes. The demographic details are given in (Table 14). First the correlation of HbA1c was done with the selected EPI parameters. From the correlation analysis parameters were identified to be considered in the regression analysis. In all the three cases, no significant correlation was established between HbA1c and the EPI parameters. However, a correlation was seen between HbA1c and right kidney (p=0.17 r= 0.19) in case of normal subjects (Table 15); between HbA1c Vs liver (p=0.15 r=0.36), Vs pancreas (p=0.16 r= 0.35), Vs intensity (p=0.16 r= 0.35), Vs form coefficient (p=0.11 r= -0.39) in the case of pre diabetics (Table 16); between HbA1c Vs right kidney (p=0.16 r= .38), Vs entropy (p=0.18 r=-0.3178) in the case of diabetics (Table 17). These were the parameters chosen for regression analysis in

each of the three groups. No significant results were observed (Tables 18, 19, & 20) which means that there is no correlation between HbA1c and EPI parameters.

Table 14: Demographic details

Groups(N)	Mean age±SD	Male no. Mean Age±SD	Female no. Mean Age±SD
Normal (50)	38.6 ± 10.2 years	n=25 37.2±9.74years	n=25 40±10.7years
Pre diabetic (17)	48±14.49 years	n=03 61±18.52years	n=14 48±14.49years
Diabetic (19)	51.05 ± 10.29 years	n=06 54.83 ±8.23 years	n=13 49.31 ± 10.96 years

SD –Standard deviation

Table 15: Correlation Analysis Normal

HbA1c/with	**t**	**df**	**p**	**r**
Area	0.7669	48	0.4469	0.1100
Cerebral	-0.1947	48	0.8464	-0.0281
Coronary	0.7934	48	0.4314	0.1137
Immunity	0.3811	48	0.7047	0.0549
Liver	- 0.7606	48	0.4506	- 0.1091
Lt Kidney	-0.3254	48	0.7462	-0.0469
Pancreas	0.8797	48	0.3834	0.1259
Rt Kidney	1.3614	48	0.1797	0.1928
Intensity	0.1026	48	0.9187	0.0148
Entropy	-0.1124	48	0.9110	-0.0162
Form Coeff	0.0391	48	0.9689	0.0056
Fractility	-0.6083	48	0.5458	-0.0874

t-'t' test; df- degree of freedom; p-level of significance, $p<0.05$ considered significant; r-level of correlation varies between +1and -1. Both values considered high correlation

Table 16: Correlation Analysis Pre-diabetic

HbA1c/with	t	df	p	r
Area	1.1499	15	0.2682	0.2846
Cerebral	-0.0817	15	0.9360	-0.0210
Coronary	0.1959	15	0.8473	0.0505
Immunity	0.9717	15	0.3466	0.2433
Liver	1.5190	15	0.1496	0.3651
Lt Kidney	0.1109	15	0.9131	0.0286
Pancreas	1.4842	15	0.1585	0.3578
Rt Kidney	0.1921	15	0.8502	0.0495
Intensity	1.4752	15	0.1608	0.3559
Entropy	0.4355	15	0.6694	0.1117
Form Coeff	-1.6764	15	0.1144	-0.3972
Fractility	-0.3434	15	0.7360	-0.0833

t-'t' test; df- degree of freedom; p-level of significance, $p<0.05$ considered significant; r-level of correlation varies between +1and -1. Both values considered high correlation

Table 17: Correlation Analysis Diabetic

HbA1c/with	t	df	p	r
Area	1.242	17	0.2311	0.2884
Cerebral	1.2457	17	0.2298	0.2892
Coronary	0.2885	17	0.7764	0.0698
Immunity	1.2537	17	0.2269	0.2909
Liver	0.9002	17	0.3806	0.2133
Lt Kidney	0.9234	17	0.3687	0.2185
Pancreas	0.6674	17	0.5135	0.1597
Rt Kidney	1.4761	17	0.1582	0.3370
Intensity	0.0972	17	0.9237	0.0235
Entropy	-1.3824	17	0.1848	- 0.3178
Form Coeff	-0.2800	17	0.7828	-0.0677
Fractility	0.1786	17	0.8604	0.0432

t-'t' test; df- degree of freedom; p-level of significance,$p<0.05$ considered significant; r-level of correlation varies between +1and -1. Both values considered high correlation

Table 18: Regression analysis Normal

	Estimate	Standard Error	t value	p
Intercept	5.20	0.03	135.357	<2e-16***
Right Kidney	0.10	0.07	1.361	0.18 Not significant

t- 't'test; p- level of significance, p<0.05 considered significant

Table 19: Regression analysis Pre diabetic

	Estimate	**Standard Error**	**t value**	**p**
Intercept	6.22	2.04	3.051	0.0101*
Liver	0.10	0.25	0.434	0.6721 Not significant
Pancreas	0.05	0.22	0.229	0.8226 Not significant
Intensity	0.00	0.02	0.005	0.9962 Not significant
Form Coefficient	-0.01	0.02	-0.481	0.6394 Not significant

t- 't'test; p- level of significance, p<0.05 considered significant

Table 20: Regression analysis Diabetic

	Estimate	**Standard Error**	**t value**	**p**
Intercept	23.73	14.25	1.665	0.115 Not significant
Entropy	-7.29	7.21	-1.011	0.327 Not significant
Right Kidney	1.03	0.91	1.124	0.277Not significant

t- 't'test; p- level of significance, p<0.05 considered significant

7.3 DIABETES TYPE 2 AND YOGA

In the first study we observed significant difference in means for Average intensity [diabetes & normal=5.978 (p= 0.000), diabetes & pre diabetes = 6.676 (p= 0.017)]; Form coefficient [diabetes & normal = - 3.590 (p=.001), diabetes & pre diabetes = -4.158 (p= 0.032)]; Immune organs [diabetes & normal = 0.281 (p=0.000), diabetes & pre diabetes =-5.890 (p=0.000) and normal & pre diabetes = -6.171 (p=000)] (Table 21, 22, 23). Apart there were very small differences (but very significant) observed in many other parameters as in Table 24. In the second study significant observations were pertaining to Immune organs (difference in means 0.201 p= 0.031; Table 25). In the third i.e., pre –post study the noticeable observation was as follows. Area (mean difference 630.37 p= 0.00), Form coefficient (mean difference -1.78 p=0.00), Entropy (mean difference -0.02 p=0.00), liver (0.24 p=0.00), Pancreas (mean difference 0.17 p=0.02), Coronary vessels (mean difference 0.14 p=0.14), Cerebral vessels (mean difference 0.19 p=0.00) left kidney (mean difference 0.15 p=0.00), right kidney (mean difference 0.24 p=0.00; Table 26).

Table 21: Independent Sample‘t’ test; diabetes-normal

Parameter	**Diabetes**	**Normal**	**t**	**df**	**p**	**Mean**
Area	12003.320	11487.860	1.596	56.675	0.116	515.460
Intensity	84.065	78.087	4.075	70.164	0.000	5.978
Form Coefficient	11.344	14.934	-3.651	40.784	0.001	-3.590
Entropy	1.965	1.862	2.821	55.251	0.007	0.103
Fractality	1.848	1.923	-2.271	30.317	0.030	-0.075

Liver	0.274	-0.045	2.868	62.216	0.006	0.319
Immune Organs	0.085	-0.196	3.699	66.439	0.000	0.281
Pancreas	0.220	-0.261	3.691	50.377	0.001	0.481
Coronary	0.213	-0.131	4.295	48.965	0.000	0.344
Cerebral	0.263	-0.021	4.052	65.358	0.000	0.284
Left Kidney	0.258	-0.049	3.072	53.868	0.003	0.307
Right Kidney	0.242	-0.092	3.732	69.411	0.004	0.334

df- degree of freedom; p-level of significance,<0.5 considered significant; t-student ‘t’ test

Table 22: Independent Sample‘t’ test; diabetes-pre diabetes

Parameter	**Diabetes**	**Pre diabetes**	**t**	**df**	**p**	**Mean**
Area	12003.320	11597.770	1.658	17.811	0.114	405.550
Intensity	84.065	77.388	2.655	16.611	0.017	6.676
Form Coefficient	11.344	15.502	-2.399	13.519	0.032	-4.158
Entropy	1.965	1.770	3.571	16.307	0.002	0.195
Fractality	1.848	1.987	-4.041	12.922	0.001	-0.139
Liver	0.274	0.105	1.477	27.664	0.151	0.169
Immune Organs	0.085	5.975	-15.681	12.421	0.000	-5.890

Pancreas	0.220	0.096	0.968	23.075	0.343	0.124
Coronary	0.213	-0.050	3.344	22.295	0.003	0.263
Cerebral	0.263	-0.007	2.752	18.912	0.013	0.270
Left Kidney	0.258	0.053	1.658	18.679	0.114	0.205
Right Kidney	0.242	-0.062	2.504	20.437	0.021	0.304

df-degree of freedom; p-level of significance,<0.5 considered significant; t-student ‘t’ test

Table 23: Independent Sample‘t’ test; normal-pre diabetes

Parameter	**Normal**	**Pre diabetes**	**t**	**df**	**p**	**Mean**
Area	11487.860	11597.770	-0.231	23.045	0.819	109.910
Intensity	78.087	77.388	0.273	17.527	0.788	0.698
Form Coefficient	14.934	15.502	-0.298	19.020	0.769	-0.567
Entropy	1.862	1.770	1.567	20.849	0.132	0.092
Fractality	1.923	1.987	-1.362	32.524	0.183	-0.064
Liver	-0.045	0.105	-1.187	32.350	0.244	-0.150
Immune Organs	-0.196	5.975	-16.375	12.585	0.000	-6.171
Pancreas	-0.261	0.096	-2.315	34.320	0.027	-0.357
Coronary	-0.131	-0.050	-0.849	34.314	0.402	-0.081
Cerebral	-0.021	-0.007	-0.138	21.550	0.892	-0.014
Left Kidney	-0.049	0.053	-0.740	25.851	0.466	-0.102
Right Kidney	-0.092	-0.062	-0.244	22.019	0.809	-0.031

df- degree of freedom; p-level of significance,<0.5 considered significant; t-student ‘t’ test

Table 24: Combined highly significant results of Independent Sample‘t’ test

		t	**df**	**p-value**	**Mean of differences**
Av. Intensity	DAI,NAI	4.075	70.164	0.0001194	5.978
	DAI ,PDAI	2.655	16.611	0.017	6.676
Form Coefficient	DFC,NFC	-3.651	40.784	0.001	-3.590
	DFC ,PDFC	-2.399	13.519	0.032	-4.158
Entropy	DEN,NEN	2.821	55.251	0.007	0.103
	DEN ,PDEN	3.571	16.307	0.002	0.195
Fractility	DFR,NFR	-2.271	30.317	0.030	-0.075
	DFR ,PDFR	-4.041	12.922	0.001	-0.139
Liver	DLI,NLI	2.868	62.216	0.006	0.319
Immunity	DIM,NIM	3.699	66.439	0.000441	0.281
	DIM ,PDIM	-15.681	12.421	1.479e-09	-5.890
	NIM ,PDIM	-16.375	12.585	7.362e-10	-6.171
Pancreas	DPA, NPA	3.691	50.377	0.001	0.481
	NPA ,PDPA	-2.315	34.320	0.027	-0.357
Coronary	DCO,NCO	4.295	48.965	8.259e-05	0.344
	DCO ,PDCO	3.344	22.295	0.003	0.263
Cerebral	DCE,NCE	4.052	65.358	0.0001376	0.284
	DCE ,PDCE	2.752	18.912	0.013	0.270
Left Kidney	DLT,NLT	3.072	53.868	0.003	0.307
Right Kidney	DRT,NRT	3.732	69.411	0.004	0.334
	DRT, PDRT	2.504	20.437	0.021	0.304

df-degree of freedom; p-level of significance,<0.5 considered significant; t-student ‘t’ test; D-diabetes; PD-pre diabetes; N-normal; AI -average intensity; FC- form coefficient; EN-entropy; FR-fractility; LI-liver; IM-immunity; PA-pancreas; CO-coronary, CE-cerebral; LT-left kidney; RT-right kidney

Table 25: Independent sample‘t’ test controlled –uncontrolled diabetes

Parameter	**Controlled**	**Uncontrolled**	**t**	**df**	**p**	**Difference of means**
Area	11919.310	12071.670	-0.412	57.855	0.6819	-152.36
Cerebral	0.273	0.255	0.2136	57.045	0.8316	0.019
Coronary	0.279	0.158	1.5316	54.857	0.1314	0.121
Entropy	1.977	1.954	0.57251	50.813	0.5695	0.023
FC	10.747	11.833	-1.2867	53.368	0.2038	-1.085
Fractality	1.840	1.855	-1.0802	53.726	0.2849	-0.014
Immune	0.196	-0.006	2.2044	52.786	0.03188	0.201
Intensity	85.721	82.710	1.5403	55.54	0.1292	3.011
Liver	0.373	0.192	1.334	57.739	0.1874	0.181
Left Kidney	0.338	0.192	1.3318	58	0.1881	0.145
Pancreas	0.297	0.156	1.026	56.992	0.3092	0.141
Right Kidney	0.394	0.118	2.4989	55.651	0.01544	0.276

df- degree of freedom; p-level of significance,<0.5considered significant;t-student‘t’ test

Table 26: Pre –post results by paired‘t’ test

	t	**df**	**P**	**Mean of differences**
Total Area	3.8737	36	0.0004	630.4649
Av. Intensity	-0.6810	36	0.5002	-0.3887
Form Coefficient	-4.3354	36	0.0001	-1.7830
Entropy	-3.5140	36	0.0012	-0.0297
Fractality	-0.4084	36	0.6854	-0.0020
Liver	4.5659	36	5.614e-05	0.2467
Immunity	0.9274	36	0.3599	0.0517
Pancreas	2.3382	36	0.0250	0.1763
Coronary Vessels	4.3967	36	9.331e-05	0.1422
Cerebral Vessels	4.1166	36	0.0002	0.1924
Left Kidney	3.0564	36	0.0042	0.1567
Right Kidney	4.3051	36	0.0001	0.2481

df- degree of freedom; p-level of significance,<0.5 considered significant; student ‘t’ test

CHAPTER 8		
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8.0 DISCUSSION

8.1 CORRELATION STUDY: FBS AND EPI PARAMETERS

Fasting Blood Sugar (FBS) is an established biochemical marker to check glucose levels in the blood. Research continues to develop new technologies and new bio markers to provide more accurate diagnosis. EPI is such an approach. This study was carried out to find correlation of various EPI parameters with FBS in different stages of diabetes mellitus type 2. The three stages are normal, pre diabetes and diabetes. Summary of results is presented in Table 27

Table 27: FBS and EPI correlation in three categories

FBS / with	**Normal**	**Pre diabetes**	**Diabetes**
Area	Yes	No	Yes
Intensity	No	No	Yes
Entropy	No	No	Yes
Form Coefficient	Yes	No	No
Pancreas	No	Yes	No
Immune Organs	No	No	Yes
Left kidney	No	No	No
Right kidney	No	Yes	No

For normal subjects the FBS value is in the range of 70-100mg/dl. In this condition as expected no organ is affected due to diabetes. FBS value depends on general health conditions. *Total area* is representative of general health and *Form coefficient* is a measure of irregularity in the image which in turn, signifies irregular flow of energy in the system. Thus a normal FBS is correlated to these two parameters. There could be small variations in FBS within the normal limits, in this group. Since no two human bodies function alike, there would be variation in *Area* and *Form coefficient* between two normal persons as well within the same person under different conditions, which is natural. The more interesting observation is in the case of pre diabetes where FBS is showing relationship with pancreas and right kidney. While both organs are prone in diabetes, the relationship in pre diabetes stage was not known. It has very recently been reported that the changes in organs particularly the kidney and pancreas set in much earlier to diabetes being manifested (*Dallas M.E, 2015*). Kidney damage from diabetes may begin much sooner than previously thought, according to the above study. A recent study has shown that above normal sugar levels which is found in pre diabetes could also result in kidney abnormalities that could finally cause kidney failure (*Navarro A, 2015; Chamow J.A, 2015*). The results of blood test may not indicate anything abnormal in pre diabetes but the subtle effects are already seen to be happening in some connected organs. Our study on EPI clearly demonstrates this and significantly, is aligned with the latest medical research on the subject. Among diabetics, there were subjects whose diabetes was under control and also subjects whose diabetes seemed uncontrolled. This observation was based on FBS readings. For our study we considered these two groups as one. In this group we find that FBS is related both to general EPI parameters as well the organ values. Among organs are Immune organs and left kidney are most important in diabetes. Obviously with the disease now in a full blown stage, the immune organs

will be affected. Regarding left kidney, perhaps it indicates that diabetes affects both kidneys. Further, since immune functions and kidneys are showing lesser energy, they can have overall impact on the general health parameters. Thus we find correlation with Area (measure of general health), Entropy (measure of disturbances in the body, it increases with diabetes) and intensity. The results are in consonance with current medical literature and hence EPI may be a research tool to understand the energy status of various organs / systems before the manifestation of disease. Earlier studies on EPI were mostly focused on comparison of parameters in the two states viz., pre post intervention where the reference for comparison was the EPI parameter itself (Sharma B, 2014). In this study we have compared the results with known and established biochemical parameters. A workable relationship has been established between the EPI and biochemical parameters and this could help a healer in diagnosis and to assess the effectiveness of treatment (Korotkov, 2010). An additional analysis was carried out to check the correlation of EPI parameters with FBS separately for males and females. It was observed through the analysis that the response towards towards diabetes is slightly different in the two genders. Modern medical literature indicates that Indian men are more susceptible towards diabetes type 2 while complications of diabetes are more severe in women. Our regression analysis results indicate that more EPI parameters correlate with FBS in case of males than females. This is perhaps due to the reason that immune system of females is stronger than males.

8.2 CORRELATIONAL STUDY: HbA1c AND EPI PARAMETRS

In the case of HbA1c, the reading is an average of sugar levels in blood over a period of three months. EPI parameters are based on the molecular state within the body at the particular moment the measurements are taken (Balaban R.S, 2005). It depends on the level of oxidized state and the quantum of free radicals in the body at the instant (Rubik

B, 2202). This can vary from time to time depending on many factors viz., biochemical changes which itself depend on some gross as well as subtle aspects of energy flow (Cifra M, 2012). Therefore, it may not be possible that a correlation between HbA1c and EPI parameters be established, be it in the case of normal, pre diabetes or diabetes. EPI measures overall energy levels of the body which are associated with the organs /systems. These are dependent on many factors such as stress at that point of time. In the case of alternative medicine, be it through yoga, naturopathy or homeopathy, EPI can be a very valuable tool for the healer to monitor effects on the participant. The readings of EPI reflect current changes unlike HbA1c which is a measure over a period of three months. In fact there is no correlation between the two which has been demonstrated scientifically through this study. Though it is beyond the scope of this study but there is literature which shows the difference between Fasting Blood Sugar (FBS) and HbA1c. Afternoon and evening plasma glucose (post lunch, pre dinner, post dinner and bed time) show higher correlation with HbA1c than morning time points (pre-breakfast, post-breakfast and pre-lunch) (Gill G.V, 1994). In one study, it has been argued that HbA1c should not be recommended as a routine test for screening of diabetes. There are problems in standardization (Tanaka Y, 2001) and factors like abnormal haemoglobin, anaemia and some drugs affect the results (Kilpatrick E.S,2008).Also there are demographic factors like race and gender (GindeA.A,2008; Anand S.S,2003). These strengthen our argument that even though both FBS and HbA1c are the biomarkers for diagnosis of diabetes, yet they may not have a correlation. It is a strong revelation that if ever we have to correlate EPI parameters with biochemical parameters, the later must not be the average values based over a period of time. Therefore, between the HbA1c and FBS, it is the FBS that should be considered for scientific study on EPI.

8.3 DIABETES TYPE 2 AND YOGA

The purpose of this study was to evaluate whether the parameters of EPI are indicative of some aspects of diabetes mellitus type 2. In the first study three stages of diabetes were considered viz., normal, pre diabetes and diabetes. Independent‘t’ test between diabetes and normal, diabetes and pre diabetes, normal and pre diabetes showed significant results. There is noticeable difference in the parameters between diabetes and normal and the difference is highly significant. Average intensity, entropy, liver, pancreas, immune organs coronary vessels, cerebral vessels, left kidney, right kidney all are more in diabetes state than the normal. Higher values are indicative of disorder. Fractality and form coefficient are a measure of irregularity in the external contour. The images are more regular in normal condition than the diabetes and hence have a higher value in normal condition. This is in line with the theory of EPI that the average intensity and entropy are high with aging and progression of disease, form coefficient and fractality are lesser. Similarly, there is noticeable difference in the selected parameters in diabetes and pre diabetes and is highly significant. However, the difference in integral area of liver, pancreas and left kidney is not significant. This could be due to the fact that these organs are affected at the pre diabetic stage itself as they would be at the diabetic stage (Bhat Romesh.K, et.al 2016). Another important aspect is immune organs. Results indicate that immune organs get more compromised at the pre diabetic stage which paves the way for disease to progress and become devastating, the body becomes vulnerable to multiple problems. This study has revealed the noticeable differences in the three stages i.e., normal, pre- diabetes and diabetes. In the second study we considered controlled diabetes and uncontrolled diabetes. The controlled diabetes as per American Diabetes Association was considered as FBS <126 mg/Dl and above this as uncontrolled. There was small noticeable but significant difference in the

immune organs. It is a negative difference in line with the earlier argument that immune organs are compromised much earlier than the extreme manifestation of the disease in this case of diabetes mellitus type 2. In rest of the parameters there is no significant change. It perhaps shows the state of these organs in the diabetes whether controlled or uncontrolled. Here is a very important observation that EPI parameter of Immune organs: 1. has correlation with diabetes (study 1); 2.is the only parameter where there is difference in all the three conditions i.e., normal vs pre diabetes, pre diabetes vs diabetes and diabetes vs normal (study 3); 3.shows significant change in controlled and uncontrolled diabetes. This highlights the role of immune organs in diabetes type 2. While the role of immunity is well known in the case of diabetes type 1, its role in diabetes type 2 is not established in modern medicine. The present study shows the role of immune organs in diabetes type 2 (Pickup 2004; Shu.et.al 2012).This paves the way for change in approach for the management of diabetes type 2, by inclusion of immune therapy along with conventional diabetes medicine. In the pre post study, we observed sizeable differences in many parameters from the paired‘t’ test. These are total area, form coefficient, entropy, coronary vessels, cerebral vessels, pancreas, left kidney and right kidney. The intervention of yoga makes the change. How much is the effect of this change or conversely what is the correct change to make a visible change in a diabetic subject is a topic for another research. As mentioned earlier, area increases with aging and with disturbed state of health. Reduction in the area indicates improvement. Entropy is indicative of stability of energy field and negative sign shows that a correction has happened in post state. Results show stability is more and hence the disturbance is less in the post state. Similarly, there is increase in form coefficient and hence the improvement in irregularity of the image. Liver, pancreas coronary vessels, cerebral vessels, kidneys are the organs that are affected by diabetes. We see reduction in the

integral area of these parameters taking them towards normal values after yoga intervention, how so ever little it may be. Thus we see that 7 days of yoga related to diabetes brings general feeling of well being and some changes at the organ level, howsoever subtle it may be. The broad clues taken from all this study is that EPI does indicate changes at the general level as well organ/system level in the different conditions of diabetes. However for a change to percolate to a good health the duration of the SDM yoga practice needs to be of much longer duration. There is direct evidence of progressive change in most of the selected parameters from normal to pre diabetes to diabetes (Table 3-4 and Fig.10-21). These findings if properly applied by the practitioners can help them a lot to know about the disease, design therapy and monitor the effect of therapy.