



## Clinical assessment of *Sara and Blood investigations in Madhumeha (T2DM)*

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### ABSTRACT

*Pratyaksha* (direct perception), *Anumana* (inference), *Aptopadesha* (testimony), and *Yukti* (reasoning) are the tools that helps for the diagnosis of the disease. To fulfill this purpose *Atura-Pariksha* (examination of patients), *Dravya Pariksha* (examination of medicinal drug and preparations), and *Roga-Rogi Pariksha* (examination of the patient and disease), etc. are a very important tool. The concept of *Sara* is described under *Dashavidha Atura Pariksha* (tenfold examination), and it is an important concept in both *Swastha-rakshana* (maintenance of health) and *Aturasya Vikara Prashamana* (treatment of disease). The concept of *Sara* is explained by different *Acharyas* elaborately in their own way. In spite of tremendous success in modern medical science, the incidence of diseases are increasing enormously. A sedentary lifestyle and improper dietary habits has led to the emergence of several health problems, including Type 2 Diabetes Mellitus (T2DM), and it is emerging as a major disease affecting mankind with many complications. Hence present study has been undertaken to understand *Sara* because all persons vary from one another in many ways, and a personalized approach to patient care should be adopted to plan appropriate therapeutics. Dietary factors, lifestyle, and psychological factors are involved in the aetiology of *Madhumeha* (T2DM). The *Twak Sara*, *Shukra Sara*, *Asthi Sara*, and *Majja Sara* persons are more prone to develop *Madhumeha* (T2DM). The *Meda Sara* and *Mamsa Sara* are less prone to develop *Madhumeha* (T2DM). We don't find the *Rakta Sara* individuals in our study.



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### INTRODUCTION

*Ayurveda* is the term used for the traditional medicine of India, and it is a science deals with the well being of mankind and serving *humanity* continuously *since time immemorial*. It is a sophisticated holistic system of medicine has been handed down from generation to generation. It explains the concept based on certain fundamental principles and ideologies. This system met the needs of local communities for many centuries. It is one of the potentially important resources for the deliv-

ery of health care in many ways like protection of health in a healthy individual, prevention of disease, and cure of the disease. Medicinal plants are the oldest known health care products, and their importance to the health of individuals and communities was widely accepted and was recorded since many decades. On the contrary, Modern Medical Science deals with humanity based on certain principles developed through science discoveries (Byadgi, 2009). *Ayurveda* is one of the most comprehensive holistic health care systems in the world. Thorough examination of the patient is the initial step in clinical medicine, followed by planning suitable, appropriate therapy. *Ayurveda* is an evolved as evidence-based practice (EBP), and its main features is the reliance on the evidence gained by continuous experiments and practice, clinical expertise, and individual patient needs and choices. If physician initiate the therapy without accurate diagnosis of the disease then accomplishment of the desired object is only by chance and will not get name & fame; on the contrary, if physician prescribe therapy after proper diagnosis and plans the principle line of treatment after considering morbidity of pathogenetic factors, strengths, place, seasons, etc; definitely he will get success.

*Prameha* is a syndrome manifest by involving intricate communication between *Dosha and Dushya* inside the *Srotasas* (multiple system) especially in *Mutravaha Srotas* (Genito-urinary system) leading to development of several distinct types and are caused by a complex interaction of genetics (*Sahaja, Kulaja, Jataja, Adibala Pravritta, Anushangi*), lifestyle factors (*Apathyanimitaja*) and environmental factors and its management is challenging till date in spite of advancement in the medical science (Byadgi, 2017a).

*Madhumeha* (T2DM) is a chronic disease that occurs when the *Kapha, Pitta and Vata Doshas* interact with *Meda, Rakta, Shukra, Ambu, Vasa, Lasika, Majja, Rasa, Oja, and Mamsa* by involving many *Srotases* (multiple systems) and it is caused by a complex interaction of genetics and environmental factors and it is characterized by frequent and copious micturition similar to *Madhu* (honey) having *Kashaya* (Astringent) and *Madhura-Rasa* (Sweet Taste), *Ruksha* (Rough to the taste/Ununctuous) and honey-like colour and over time leads to serious damage to multisystem of the body (*Srotasas*), especially the *Prameha Pidakas* and other complications (Byadgi, 2017a).

In *Ayurvedic Classics*, *Acharya Charaka* has narrated *Dashavidha Pareeksha* (ten-fold examination), i.e., *Prakriti, Vikriti, Sara, Samhanana, Pramana, Satmya,*

*Satwa, Ahara Shakti, Vyayamashakti, and Vaya* to rule out the *Roga Bala* (strength of diseases) and *Rogi Bala* (strength of patients) (Byadgi, 2018b). It indicates a personalized approach to patient care because individuals vary from one another in many ways — what they eat, the types and amount of stress they experience, exposure to environmental factors, and their DNA. Personalized medicine is the use of new methods of molecular analysis to better manage a patient's disease or predisposition toward disease. *Sara's* examination is a very important tool for the assessment of the biological strength of the patient as well as mental strength. In *Ayurveda*, the term *Sara* has been explained to denote the essence of *Dhatu* with excellent quality. It is the central governing force responsible for the biological strength of the body tissue. In terms of present-day knowledge, *Sara* may be considered as the optimum degree of genetic code with regard to the structural and functional peculiarity of an organ system. All those factors responsible for good biological qualities of *Dhatu*, it may come under the purview of *Sara*. In the clinical practice, sometimes the physician may take a wrong decision only by seeing the body of the patient, i.e., the person is strong because he possessed a stout body and weak because of a lean body. But factually, it is observed that some persons who possess a lean body are strong enough to resist the adverse situation and vice versa. Hence *Sara's* examination is very important prior to the administration of drugs and diet to the patients in clinical practice (Byadgi, 2018b).

In spite of tremendous success in modern medical science, the incidence of diseases are increasing enormously. A sedentary lifestyle and improper dietary habits has led to the emergence of several health problems, including Type 2 Diabetes Mellitus (T2DM), and it is emerging as a major disease affecting mankind with many complications. Hence present study has been undertaken to understand *Sara* because all persons vary from one another in many ways, and a personalized approach to patient care should be adopted to plan appropriate therapeutics. Hence present clinical study entitled "Clinical assessment of *Sara* and Blood investigations in *Madhumeha* (T2DM)" was undertaken to personalize the patient care and approach should be made accordingly for better control.

## MATERIALS AND METHODS

The present study entitled "Clinical assessment of *Sara* and Blood investigations in *Madhumeha* (T2DM)" has been carried out in the department of *Kriya Sharir*, Department of *Vikriti Vigyan*, Faculty of

*Ayurveda*, and from OPD and IPD of *Vikriti Vigyan & Kaya Chikitsa*, S. S Hospital, IMS, BHU, Varanasi.

### The aims & objectives of the study

1. Assessment of Sara in Madhumeha (T2 DM)
2. Analysis of blood investigations in various Sara in Madhumeha (T2 DM)
3. To find out the possible relationship between Sara and Madhumeha (T2 DM)

### Plan of Study

The details of the research plan of the present clinical study

1. Registration of the patients of Madhumeha (T2DM) was done after obtaining written consent
2. Registration of the patient was done after considering the inclusion and exclusion criteria and fulfillment of the diagnostic criteria of Madhumeha (T2DM).
3. Assessment of Dhatu Sara was done using the questionnaire
4. Biochemical investigations such as FBS (FPG), PPBS (2 Hr PG), and HbA1c of all the patients.
5. Haematological investigation including Hb%, RBC Count, WBC count, RFT, LFT of all the patients.
6. The Analysis of data has been done by using Statistical software SPSS version 16.0.

### Registration of Patients

This study is a cross-sectional observational study. Prior to registration of individuals in the study, they were screened for *Madhumeha* (Type 2 Diabetes Mellitus) from the OPD of *Vikriti Vigyan*, and from OPD and IPD of *Vikriti Vigyan & Kayachikitsa*, S. S Hospital, IMS, BHU, Varanasi. A total of 150 patients of *Madhumeha* (Type 2 Diabetes Mellitus) were registered initially, out of which 28 subjects were excluded due to incomplete data, and finally, 122 subjects were registered.

**The inclusion and exclusion criteria of the present study are as follows**

#### Inclusion Criteria

1. Age 25-60 years of either sex
2. The patients fulfilling the diagnostic criteria of Madhumeha (T2DM).

3. Individuals who were willing to participate in the study by giving their written consent on prescribed format.

#### Exclusion Criteria

1. Age <25 years and >60 years.
2. The individuals who were not willing to participate in the study.
3. The patients suffering from complications of Madhumeha (T2DM).

Individuals were given detailed information about the purpose and methods used in the study, and written consent was obtained from them before registration. This study was approved from the ethical committee of the Institute of Medical Sciences, Banaras Hindu University.

#### Assessment of Dhatu Sara

Assessment of *Dhatu Sara* was done by using Proforma (Gunawat, 2014). Its assessment was based upon the characters mentioned in different classics of *Ayurveda*. Keeping the original idea or character intact, as described in *Ayurvedic* text, the Proforma has been designed containing simple, accessible questions. The allotted scores were specified against the statement in a separate column for particular *Sara* (except *Rakta Sara* and *Mansa Sara*). In *Rakta Sara*, initial ten questions having three features of a single body part, and each feature was given one mark, ultimately having total score 3. Last seven questions having one mark for each question. The marks were divided on the basis of characters of each body part described in the different text of *Ayurveda*. In *Mansa Sara*, up to question fourteen, each question having two features of a single body part. Each feature was given one marks, ultimately having total score two and the rest of the questions having one marks. At the end, the total scores for different *Sara* was calculated in the form of percentage with the help of simple mathematical calculation.

Score of Sara (in percentage)=

$$\frac{\text{Total score Obtained}}{\text{Total score Alloted}} \times 100$$

#### Statistical Analysis

All the data collected from the patients were filled into an excel sheet. The Analysis of data has been done by using Statistical software SPSS version 16.0.

The following Statistical tests were applied wherever found necessary:

#### Mean of different observations

The mean of different observations in each group was calculated with the help of the following formula,

$$\bar{X} = \frac{\sum x}{n}$$

$\bar{X}$  = mean

$\sum$  = a sum of

$X$  = a single observation

$n$  = number of observations

### Standard Deviation (S.D.)

To measure the variability in the given set of data standard deviation (SD) is calculated using the following formula.

$$SD = \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n - 1}}$$

### One way ANOVA

For intergroup comparison of means of more than 2 groups, one-way analysis of variance, F-test was applied, followed by appropriate Post-Hoc Test for pair-wise determination of significance.

### Chi-square test

For intragroup comparison of ordinal variable and dichotomous variable Friedman chi-square test had been applied respectively. Pearson chi-square test was used for intergroup comparison.

### Statistical Significance

$p < 0.05$  considered as statistically significant

$p < 0.01$  or  $p < 0.001$  considered as statistically highly significant

$p > 0.05$  considered as not statistically significant

## RESULTS AND DISCUSSION

The present study entitled "Clinical assessment of Sara and Blood investigations in Madhumeha (T2DM)" has been carried out in association with Department of Kriya Sharir, Department of Vikriti Vigyan, Faculty of Ayurveda, and from the OPD of Vikriti Vigyan, and from OPD and IPD of Vikriti Vigyan & Kayachikitsa, S.S Hospital, IMS, BHU, Varanasi.

The above Table 2 shows that the mean value of FBS, PPBS, and HbA1c as per different Sara except Rakta Sara because Rakta Sara patients were not found in the study. It was observed that the mean of FBS

was maximum in *Majja Sara* ( $174.86 \pm 27.82$ ) and minimum in *Meda Sara* ( $155.40 \pm 22.49$ ) patients. Mean of PPBS was found maximum in the case of *Meda Sara* ( $287.86 \pm 68.09$ ) and minimum in *Mansa Sara* ( $250.04 \pm 28.93$ ) patients. Moreover, the mean of HbA1c was found maximum in *Majja Sara* ( $8.59 \pm 1.60$ ) and minimum in *Asthi Sara* ( $7.33 \pm 2.37$ ) patients.

The above Table 3 shows that the mean of value Hb was maximum in *Majja Sara* ( $13.48 \pm 1.29$ ) and minimum in *Mansa Sara* ( $11.64 \pm 2.11$ ) subjects. Similarly, the mean of Platelets count was observed maximum in *Asthi Sara* ( $190562.50 \pm 59522.50$ ) and minimum in *Mansa Sara* ( $148501.66 \pm 67547.23$ ) subjects. Mean of RBCs was maximum in *Asthi Sara* ( $4.86 \pm 0.56$ ) and lowest in *Mansa Sara* ( $4.35 \pm 0.71$ ) subjects. The mean value of WBCs was observed maximum in *Asthi Sara* ( $11555.62 \pm 1402.16$ ) individuals and a minimum in *Meda Sara* ( $5649.26 \pm 2016.27$ ).

The above Table 4 shows that the mean value of Neutrophil was highest in *Mansa Sara* ( $63.04 \pm 9.48$ ) and minimum in *Majja Sara* ( $56.79 \pm 9.17$ ) individuals while the mean value of Lymphocyte was highest in *Majja Sara* ( $34.19 \pm 7.51$ ) individuals and minimum in *Mansa Sara* ( $27.53 \pm 10.55$ ). However, the mean value of Eosinophil and Monocyte was found highest in *Shukra Sara* ( $4.35 \pm 2.24$  and  $7.09 \pm 1.36$ ), Basophil in *Mama Sara* ( $0.42 \pm 0.36$ ) participants while the minimum mean value of Eosinophil and Monocyte minimum in *Meda Sara* ( $2.76 \pm 1.27$ ), and *Shukra Sara* ( $4.51 \pm 1.79$ ) participants respectively. In the case of Monocyte, the mean value was observed maximum in *Shukra Sara* ( $7.09 \pm 1.36$ ) and minimum in *Majja Sara* ( $4.51 \pm 1.79$ ) patients. Mean value of Basophil was found higher in *Mansa Sara* ( $0.42 \pm 0.26$ ) patients and minimum in *Shukra Sara* ( $0.24 \pm 0.12$ ) patients.

The above Table 5 shows the mean value of Liver Function Test (LFT) in various Sara individuals. From the table, it was observed that the mean value of Serum Albumin was found maximum in *Meda Sara* ( $4.60 \pm 0.24$ ) and approximately the same in *Majja Sara* ( $4.59 \pm 0.30$ ) patients and minimum in *Mansa Sara* ( $4.27 \pm 0.37$ ) patients. The mean value of Serum Alkaline Phosphatase was found very high in *Meda Sara* ( $153.22 \pm 63.41$ ) patients and minimum in *Shukra Sara* ( $108.03 \pm 42.41$ ) patients. Further, it was observed the mean value of Serum Direct Bilirubin was noticed maximum in *Mansa Sara* ( $0.34 \pm 0.29$ ) patients and minimum value in *Twak Sara* ( $0.27 \pm 0.19$ ) patients. Mean value of Serum Total Bilirubin was found in *Majja Sara* ( $1.07 \pm 0.60$ ) patients and minimum in *Twak Sara* ( $0.64 \pm 0.36$ )

**Table 1: showing the gender-wise distribution of *Madhumeha* (Type 2 Diabetes Mellitus) patients**

Gender	Number	Percentage
Male	84	(68.85%)
Female	38	(31.15%)
Total	122	100%

The above Table 1 shows that out of 122 patients, 84 (68.85%) subjects were male, and 38 (31.15%) were female.

**Table 2: showing the relationship of FBS, PPBS and HbA1c in *Madhumeha* (Type 2 Diabetes Mellitus) patients as per *Sara***

Blood Sugar (Mean±SD)	Sara						Between Group Comparison, Chi-Square test
	<i>Twak Sara</i>	<i>Mansa Sara</i>	<i>Meda Sara</i>	<i>Asthi Sara</i>	<i>Majja Sara</i>	<i>Shukra Sara</i>	
	46 (37.70%)	9 (7.3%)	9 (7.37%)	17 (13.93%)	15 (12.29%)	26 (21.1%)	
FBS	156.43±35.73	160.98±36.12	155.40±22.49	161.69±28.73	174.86±27.82	167.69±37.62	F=0.90, p=0.47
	261.79±68.10	250.04±28.93	287.86±68.09	269.98±56.29	276.45±71.42	268.83±55.93	F=0.47, p=0.79
HbA1c	8.21±1.43	7.34±2.83	8.22±1.01	7.33±2.37	8.59±1.60	8.17±2.47	F=1.00, p=0.42

**Table 3: showing the relationship of Hb, Platelets, WBC, and RBC in *Madhumeha* (Type 2 Diabetes Mellitus) patients as per *Sara***

Haematolog parameters Mean±SD	Sara						Between Group Comparison, Chi-Square test
	<i>Twak Sara</i>	<i>MamsaSar</i>	<i>Meda Sara</i>	<i>Asthi Sara</i>	<i>Majja Sara</i>	<i>Shukra Sara</i>	
	46(37.70%)	9(7.37%),	9(7.37%),	17(13.93%),	15(12.29%)	26(21.31%)	
Hb	13.44±1.40	11.64±2.11	13.35±0.86	13.05±1.65	13.48±1.29	12.53±1.67	F=1.03, p=0.01
Platelets	167160.±	148501±	149222.22±	190562.50±	188888.±	179307.±	F=1.07, P=0.38
	57803.72	67547.23	42210.12	59522.50	65273.74	70205.62	
RBC	4.74±0.41	4.35±0.71	4.67±0.38	4.86±0.56	4.62±0.41	4.58±0.54	F=1.61, p=0.16
WBC	8495.04±	7165.55±	5649±2016.27	11555.62±1402.16	7304.44±	6721.07±	F=1.04, P=0.39
	3185.40	2519.89			1302.70	2594.59	



**Table 4: showing the relationship of Differential Leukocyte count (DLC) in Madhumeha (Type 2 Diabetes Mellitus) patients as per Sara**

Differential Leukocyte count Mean±SD	Sara						Between Group Comparison, Chi-Square test
	<i>Twak Sara</i>	<i>Mamsa Sara</i>	<i>Meda Sara</i>	<i>Asthi Sara</i>	<i>Majja Sara</i>	<i>Shukra Sara</i>	
	46 (37.70%)	9 (7.37%)	9 (7.37%)	17 (13.93%)	15 (12.2%)	26 (21.31%)	
Neutrophil	57.45±8.02	63.04±9.48	60.53±7.53	59.86±10.12	56.79±9.17	59.68±7.02	F=1.06, p=0.38
Lymphocyte	32.65±8.28	27.53±10.55	28.82±6.19	30.96±8.26	34.19±7.51	29.80±6.31	F=1.46, p=0.20
Eosinophil	4.01±2.51	3.36±2.08	2.76±1.70	3.23±1.96	3.42±2.45	4.35±2.24	F=0.71, p=0.61
Monocyte	6.44±1.73	5.37±1.88	5.76±1.12	7.27±1.09	4.51±1.79	7.09±1.36	F=0.29, p=0.91
Basophil	0.32±0.23	0.42±0.26	0.27±0.13	0.26±0.11	0.27±0.09	0.24±0.12	F=1.05, p=0.33

**Table 5: showing the relationship of Liver Function Test (LFT) in Madhumeha (Type 2 Diabetes Mellitus) patients as per Sara**

Liver Function Test Mean±SD	Sara						Between Group Comparison, Chi-Square test
	<i>Twak Sara</i>	<i>Mamsa Sara</i>	<i>Meda Sara</i>	<i>Asthi Sara</i>	<i>Majja Sara</i>	<i>Shukra Sara</i>	
	n=46 (37.7)%	n=9 (7.37)%	n=9 (7.37)%	n=17 (13.93)%	n=15 (12.29)%	n=26 (21.31)%	
Albumin	4.45±0.35	4.27±0.37	4.60±0.24	4.41±0.45	4.59±0.30	4.46±0.32	F=1.27, p=0.27
Alkaline Phosphatase	119.59±41.53	133.21±58.57	153.22±63.41	125.15±50.68	123.53±28.56	108.03±42.41	F=1.10, p=0.36
Bilirubin Direct	0.27±0.19	0.34±0.29	0.28±0.07	0.29±0.38	0.24±0.11	0.28±0.29	F=0.20, p=0.95
Bilirubin Total	0.64±0.36	0.67±0.24	0.68±0.23	0.58±0.19	1.07±0.60	0.82±0.49	F=0.63, p=0.67
SGOT	35.09±13.15	28.94±12.63	54.25±10.95	25.81±7.65	29.81±8.04	27.63±9.1	F=1.40, p=0.22
SGPT	43.98±14.55	38.26±16.03	41.22±20.29	29.88±13.62	37.27±17.86	30.61±13.53	F=0.87, p=0.50

patients. Mean value of SGOT was found very high in *Meda Sara* ( $54.25 \pm 10.95$ ) patients and low value in *Asthi Sara* ( $25.81 \pm 7.65$ ) patients. It was also observed that the mean value of SGPT was higher in *Twak Sara* ( $43.98 \pm 14.55$ ) patients and lower in *Asthi Sara* ( $29.88 \pm 13.62$ ) patients.

The above Table 6 shows the mean value of Serum Creatinine, Blood Urea, Specific Gravity, and pH of the urine in various *Sara* individuals. From the table, it was observed that the mean value of Serum Creatinine was higher in *Mamsa Sara* ( $0.74 \pm 0.02$ ) patients and minimum in *Shukra Sara* ( $0.40 \pm 0.01$ ) patients. The mean value of Blood Urea was observed maximum in *Meda Sara* ( $26.90 \pm 7.35$ ) patients and minimum in *Majja Sara* ( $22.18 \pm 7.09$ ) patients. The mean value of Specific Gravity of urine as per *Dhatu Sarata* was found slightly higher in *Shukra Sara* ( $1.04 \pm 0.7$ ) and lower in *Twak Sara* ( $0.90 \pm 0.04$ ) patients. It was found almost the same mean specific gravity in *Mamsa Sara* ( $1.01 \pm 0.01$ ), *Meda Sara* ( $1.01 \pm 0.01$ ), *Asthi Sara* ( $1.02 \pm 0.01$ ) and *Majja Sara* ( $1.01 \pm 0.01$ ) patients. The mean value of pH of Urine was observed almost the same higher in *Mansa Sara*, *Meda Sara*, and *Shukra Sara* patients and minimum in *Asthi Sara*. Clinically it was found within normal limits.

The above Table 7 shows the mean value of the lipid profile in various *Sara* individuals. It shows that the mean value of Serum Total cholesterol was found higher in *Meda Sara* ( $188.66 \pm 40.51$ ) patients and lowest in *Majja Sara* ( $161.53 \pm 44.05$ ) patients. The mean value of HDL was found higher in *Meda Sara* ( $55.18 \pm 6.50$ ) patients and lower in *Mansa Sara* ( $45.07 \pm 11.52$ ) patients. The above table reveals that the mean value LDL was found higher in *Majja Sara* ( $117.56 \pm 28.92$ ) and minimum in *Mansa Sara* ( $93.09 \pm 31.44$ ) patients. The mean value of Serum triglyceride was higher in *Majja Sara* ( $173.24 \pm 29.38$ ) and lower in *Meda Sara* ( $128.50 \pm 23.30$ ) patients.

*Prameha* is a syndrome manifest by involving intricate communication between *Dosha and Dushya* inside the *Srotasas* (multiple system) especially in *Mutravaha Srotas* (Genito-urinary system) leading to development of several distinct types and are caused by a complex interaction of genetics (*Sahaja, Kulaja, Jataja, Adibala Pravritta, Anushangi*), lifestyle factors (*Apathyanimittaja*) and environmental factors and its management is challenging till date in spite of advancement in the medical science. It is characterized by frequent and copious micturition with turbidity, i.e., *Prabhuta Avila mutrata* (Byadgi, 2009).

*Madhumeha (T2DM)* is a chronic disease that occurs

when the *Kapha, Pitta* and *Vata Doshas* interact with *Meda, Rakta, Shukra, Ambu, Vasa, Lasika, Majja, Rasa, Oja, and Mamsa* by involving many *Srotases* (multiple systems) and it is caused by a complex interaction of genetics and environmental factors and it is characterized by frequent and copious micturition similar to *Madhu(honey)* having *Kashaya (Astringent)* and *Madhura-Rasa(Sweet Taste)*, *Ruksha (Rough to the taste/Ununctuous)* and honey-like colour and over time leads to serious damage to multisystem of the body (*Srotasas*), especially the *Prameha Pidakas* and other complications (?).

#### Distribution of patients of *Madhumeha (T2DM)* as per *Sara*

The maximum number of participants were having *Twak Sara* (46) followed by *Shukra Sara* (26), *Asthi Sara* (17), and then *Majja Sara* (15). While a minimum number of diabetic patients were belongs to *Meda Sara* (9) and *Mamsa Sara* (9).

In *Sara* typology, the term *Rasa Sara* is not mentioned. It is described as *Twak Sara*, probably due to the reason that *Rasa Dhatu* cannot be seen separately in the living being, and functions of *Rasa Dhatu* are primarily and best manifested in the *Twak*. *Dalhaṇa* clarifies in his commentary that in *Twak Sara*, the meaning of *Twak* is the *Rasa* residing in *Twak* (Byadgi, 2018b).

The highest predominance of *Twak Sara* individuals may be due to their molecular structure, which is prone to develop T2DM, and it may be due to impairment in other dhatus. Semi digested food produces *Rasa Dhatu* circulating throughout the body produces *Meda*. *Meda* is unctuous and because of its great unctuousness leading to obesity. Obesity itself is the major cause of Diabetes. According to Sushrut "*Rasanimittmeva Sthaulyam Karshyam Cha*. (Byadgi, 2017b, 2018a)

*Rakta Dhatu* may be correlated to platelets and red blood cells due to their similarity in their functions. In our study, we did not find *Rakta Sara's* individual. Individuals having the excellence of *Rakta* are characterized by unctuousness, red colour, and beautiful dazzling of the appearance of the ears, eyes, face, tongue, nose, lips, sole of the hand and feet, nails, forehead, and genital organ (Byadgi, 2018a).

*Mamsa Dhatu* may be correlated to muscle tissues and their adjacent structures due to their similarity in their functions. As we know that the individuals having the excellence of muscles tissue is characterized by stability, heaviness, beautiful appearance and forehead, nape, eyes, cheeks, jaws, neck, shoulder, abdomen, axillae, chest and joints of upper and lower limb being covered with flesh (Byadgi,

**Table 6: showing the relationship of Kidney Function Test (KFT) in Madhumeha (Type 2 Diabetes Mellitus) patients as per Sara**

Variable Mean±SI	Sara Mean±SD						Between Group Comparison, Chi-Square test
	<i>Twak Sara</i> 46(37.70%)	<i>Mamsa Sara</i> 9(7.37%),	<i>Meda Sara</i> 9(7.37%),	<i>Asthi Sara</i> 17(13.93%)	<i>Majja Sara</i> 15(12.29%)	<i>Shukra Sara</i> 26(21.31%)	
Creatinine	0.92± 0.17	0.74± 0.02	0.92± 0.36	0.91± 0.16	0.91± 0.27	0.40± 0.01	F=1.01, p=0.01
Urea	24.62± 7.31	24.15± 5.97	26.90± 7.35	24.64± 7.96	22.18± 7.09	25.88± 7.5	F=0.66, p=0.65
Specific Gravity	0.90± 0.04	1.01± 0.01	1.01± 0.01	1.02± 0.01	1.01± 0.01	1.04± 0.7	F=1.58, p=0.03
Ph	5.93± 0.49	6.05± 0.46	6.00± 0.46	5.68± 0.47	5.90± 0.28	6.01± 0.41	F=1.10, P=0.27
Total							

**Table 7: showing the relationship of mean±SD of Lipid Profile in Madhumeha (Type 2 Diabetes Mellitus) patients as per Sara**

Variables	Sara Mean±SD						Between Group Comparison, Chi-Square test
	<i>Twak Sara</i> 46(37.70%)	<i>Mamsa Sara</i> 9(7.37%),	<i>Meda Sara</i> 9(7.37%),	<i>Asthi Sara</i> 17(13.93%)	<i>Majja Sara</i> 15(12.29%)	<i>Shukra Sara</i> 26(21.31%)	
Total	169.99± 39.14	164.77± 36.92	188.66± 40.51	177.56± 43.15	161.53± 44.05	183.17± 39.82	F=0.99, p=0.42
HDL	46.10± 11.39	45.07± 11.52	55.18± 6.50	48.40± 10.83	45.56± 9.38	47.40± 14.39	F=0.72, p=0.63
LDL	103.10± 33.49	93.09± 31.44	102.38± 22.54	99.63± 34.61	117.56± 28.92	119.24± 29.40	F=1.80, p=0.11
Triglyceride	169.91± 20.22	142.93± 27.51	128.50± 23.30	162.10± 29.99	173.24± 26.38	156.46± 26.29	F=0.45, p=0.80

2018a) Muscles fat so-called *Vasa* is one of *Dushya* of *Prameha*. In *MamsaSara*, individual the muscles tissue and fat remain in purest form qualitatively and quantitatively. That might be the reason for the least predominance of *Madhumeha* in *Mamsa Sara* individuals.

*MedaDhatu* or fat tissue is 4<sup>th</sup> among the seven *dhatu* in the sequence. It is formed from *MamsaDhatu*, and it is a precursor of *AsthiDhatu*. If *MedoDhatwagni* is in a balanced state, the fat is formed in normal quantity and in the best quality. This type of fat tissue helps in the protection of tissue and organ (Byadgi, 2018a). *Meda* (body

fat) being major *Dushya* to be get vitiated and causative factor for *Madhumeha*. But in our study, the least number of *Madhumeha* (T2DM) registered belonging to *Meda Sara*. It indicates that *Meda Sara* individuals are less prone to T2DM.

Individuals having the excellence of bone tissue are characterized by robust heels, ankles, knees, forearms, collar bones, chin, head, joints, bone, nails, and teeth belongs to *Asthi Sara* (Byadgi, 2018a). *Vata* resides in *Asthi*, *Pitta* in *Sweda* and *Rakta*, and rest in the remaining *Dhatu*s and *Malas* (tissue and waste). Due to the *AsrayaAshrayi* relationship, the increase and decrease of one may increase or decrease of



others, respectively, except in the case of *Asthi* and *Vata*. Diabetes in *AshiSara* may be due to excessive use of *Vata* provocative diet and regimens, which ultimately increase the *Vata Dosha* leading to *Madhumeha* (T2DM).

Individuals having the excellence of *Majja* or marrow are distinguished by the softness of organs, strength, unctuous complexion and voice, robust long and rounded joints are belongs to *MajjaSara* (Byadgi, 2018a). As *MajjaDhatu* is called as *Gambhir* (deeper) *Dhatu* and *Sara* of this *Dhatu* has very rare occurrence (Pathak Shruti D, 2016). That might be a possible reason for fewer occurrences in of *Madhumeha* (T2DM) in *Majja Sara* individuals. *Shukra Sara* persons suffer from *Madhumeha* (T2DM), and it has been observed in many patients. It may be due to their molecular structure, which is prone to develop T2DM, and it may be due to impairment in other dhatus.

#### **Sara wise Biochemical Parameters in Madhumeha (T2DM patients)**

It was observed that the mean value of FBS ( $174.86 \pm 27.82$ ) and HbA1c ( $8.59 \pm 1.60$ ) was maximum in *Majja Sara*. Since *Majja* is a deep-seated structure where haemopoiesis (haemoglobin and RBC formation) occurs, which requires more requirement of energy. To compensate the amount of energy for haemopoiesis, the FBS level might be elevated in *MajjaSara* Individuals. The mean value of the PPBS level was high in *Meda Sara* individuals. This might be due to the vitiation of *Meda Dhatu* up to a great extent, which is the major *Dushya* of *Madhumeha* (T2DM).

It was observed that the mean of Hb% was maximum in *Majja Sara* ( $13.48 \pm 1.29$ ) and minimum in *Mansa Sara* ( $11.64 \pm 2.11$ ) subjects. Since *Majja* is the major site of Haemoglobin formation in adult individuals. Synthesis of haemoglobin begins in the proerythroblasts and continued even in reticulocytes stage of red blood cells. Therefore when reticulocytes leave the bone marrow and pass into the bloodstream, they continue to form a minute quantity of haemoglobin until they become mature erythrocytes until they become mature erythrocyte. RBCs Counts, WBCs counts, and Platelet all were found maximum in *Asthisara* individuals because *Asthi Dhatu* resides adjacent to *Majja Dhatu* and have close relationship and dependency with each other (Mario Vaz Tony Raj Kurpad Anura, 2016). The mean value of Neutrophil ( $63.04 \pm 9.48$ ) and the percentage was highest in *Mansa Sara* individuals. It may be an important cause for good strength and muscle power in *Mamsa Sara* persons. Lymphocyte was found maximum in *Majja Sara* ( $34.19 \pm 7.51$ )

persons but within physiological limits, which indicate that *Majja Sara* persons are resistant against chronic infections. The mean value of Monocyte and Eosinophil was at a high normal level in *Shukra Sara* ( $4.35 \pm 2.24$ ,  $7.09 \pm 1.36$ ) persons, respectively. It indicates that *Majja Sara* persons are resistant against chronic infections as lymphocytes count were at high normal limits. Eosinophil count was on a high normal in *Shukra Sara* persons while Basophil ( $0.32 \pm 0.23$ ) in *Twak Sara* (Mario Vaz Tony Raj Kurpad Anura, 2016)

It was observed that the mean value of Serum Albumin was found maximum in *Meda Sara* ( $4.60 \pm 0.24$ ) and approximately the same in *Majja Sara* ( $4.59 \pm 0.30$ ) patients. Similarly, the mean value of Serum Alkaline Phosphatase was found very high in *Meda Sara* ( $153.22 \pm 123.41$ ), Serum Direct Bilirubin was noticed maximum in *Mansa Sara* ( $0.34 \pm 0.29$ ), Serum Total Bilirubin was found highest in *Majja Sara* ( $1.07 \pm 0.60$ ). Mean value of SGOT was found very high in *Meda Sara* ( $54.25 \pm 10.95$ ), and it was also observed that the mean SGPT was higher in *Twak Sara* ( $43.98 \pm 24.55$ ) patients highest bilirubin value is the cause of high HbA1C. An elevated level of bilirubin causes liver damage, which causes excess glucose remains unchanged into glycogen. On applying a Chi-Square test, very minor variation was observed, which does not show any physiological and statistically significant among all *Sara* individuals.

Serum Creatinine level was found higher in *Mamsa Sara* person. So *Mamsa Sara* person may be more prone to develop renal disorder/nephrotic syndrome. Increased Serum Creatinine level in *Mansa Sara* individual may be due to habitual intake of a large amount of protein-rich diet. Blood urea, a specific gravity of Urine and pH of the urine was within physiological limits. On applying a Chi-Square test, a significant result was not found.

It is very interesting to mention that the mean value of HDL and Total Cholesterol was traced maximum in *Meda Sara* person. It may be due to the intake of food items rich in oil and fats regularly. HDL is involved in reversed cholesterol transport. Excess cholesterol is eliminated from the body via the liver, which secretes cholesterol in the bile or converts it into bile salts. The liver removes LDL and other lipoproteins from the circulation by receptor-mediated endocytosis (Kingsbury and Bondy, 2003).

Serum triglyceride was higher in *Majja Sara*, which might be due to the consumption of a high-calorie diet. Triglyceride tends to show up along with other problems like High Blood Pressure, T2DM,

obesity, increased LDL, and Decreased HDL. But still, there are some evidences that high triglyceride itself increases the risk of disease (Kingsbury and Bondy, 2003).

## CONCLUSIONS

It can be concluded that various dietary, lifestyle, and psychologic factors are evolved in the aetiology of *Madhumeha* (T2DM). The *Twak Sara*, *ShukraSara*, *AsthiSara*, and *Majja Sara* persons are more prone to develop *Madhumeha* (T2DM). The *Meda Sara* and *Mamsa Sara* are less prone to develop *Madhumeha* (T2DM). We don't find the *Rakta Sara* individuals in our study.

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