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Short Communication

Impact of consumption of different tastes on the liver biomarkers in pregnant women: an observational pilot study

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ABSTRACT

Derangement of liver enzymes during pregnancy may represent a physiological adaptation or reflect underlying hepatic dysfunction that is pre-existing or coincidental. Multiple etiologies contribute to altered liver biomarkers in pregnancy, and identification of modifiable factors remains clinically relevant. Dietary assessment offers a potential means to understand the underlying contributors to such biochemical alterations. From an Ayurvedic perspective, diet is evaluated based on *Shad-rasa* (where shad is six and rasa is tastes), each of which exerts specific effects on body physiology and metabolic balance. Assessing dietary patterns through Shad-rasa may therefore provide insight into liver enzyme derangements during pregnancy. Pregnant women with deranged liver function tests (LFT) in the antepartum period were assessed using a structured diet history questionnaire documenting frequency and quantity of commonly consumed food items, categorized according to dominant taste profiles. Liver function parameters were classified as normal or abnormal based on standard reference ranges. Statistical analysis was performed to examine associations between dietary taste patterns and deranged LFT parameters.

Keywords: Ayurveda, Diet, Dietary items, Liver enzymes, Pregnancy, *Rasa Sevana*, *Shad-rasa*

INTRODUCTION

Pregnancy is a state of significant systemic and metabolic adaptation that enables the maternal body to meet the increasing physiological demands of the growing foetus. Alterations in bile flow and elevations in certain liver enzymes during pregnancy are primarily influenced by increased levels of estrogen and progesterone, along with placental development.[1] The resultant deranged liver function in pregnancy can have wide-ranging consequences affecting maternal metabolism, coagulation pathways, placental perfusion, and foetal well-being. Accumulation of bile acids and metabolic toxins may manifest as pruritus, fatigue, and jaundice, and in severe cases can lead to placental insufficiency, foetal compromise, intrauterine growth restriction, and increased perinatal mortality.[2,3]

Diet plays a pivotal role during pregnancy in modulating hepatic enzymatic activity by influencing metabolic load, bile secretion, oxidative stress, and inflammatory processes.[4,5] From an Ayurvedic perspective, the foetus is entirely dependent on the mother for nourishment, which is derived from maternal diet and its transformation into Rasa Dhatu (~ primary circulating nutritive fluid of the body). Therefore, pregnant female is advised to consume a diet comprising all 6 tastes (~shad-rasa) (where shad is six and rasa is tastes), as Shad-rasa Ahara (~diet comprising of all six tastes) that maintains Tridoṣha equilibrium.[6,7] Excessive or imbalanced intake of any Rasa (~taste) can vitiate Doshas, impair Agni (~digestive fire) and result in Dushti (~vitiation)of Rasa and Rakta dhatus.[8]

Impaired Agni (~digestive fire) along with Pitta Dosha vitiation leads to suboptimal Rasa formation, which

subsequently affects Rakta dhatu due to derangement of Ranjaka Pitta.[9] As Yakṛit (~Liver) is the Moolsthana (~major seat) of Raktavaha srotas, these changes may manifest as Yakṛit vikṛiti (~liver Dysfunction).[10] The present survey aims to assess the impact of dietary habits and Ṣhaḍ-rasa (~six tastes) consumption on liver function during pregnancy.

METHODS

The study is a cross-sectional study to determine the influence of diet on gestational derangement of LFTs in pregnant females. Diet Health Questionnaire by National Institute of health is a validated structured survey questionnaire. Referring to the Diet Health Questionnaire (DHQ) and Food and Agricultural Organisation (FAO) questionnaires, this questionnaire was developed adhering to the dietary habits of the regional population and used in the study to determine the food items that were consumed by pregnant females of 2nd and 3rd trimester of the age group 20 to 35 years having deranged LFT. The data was obtained from 100 patients form the antenatal out-patient department of a Tertiary Care Ayurveda hospital in New Delhi. 1st trimester females with deranged LFT, patients below 20 years and above 35 years, patients with known liver diseases like pre-existing hepatobiliary diseases, NAFLD, viral hepatitis, cholecystitis, cholelithiasis, cholangiosarcoma, liver abscess, liver cancer or any mass in the liver, autoimmune liver disease, etc were excluded to minimize confounders. The privacy and confidentiality of all the participants was maintained. Dietary questionnaire was administered during the outpatient visit at which LFT abnormalities were first detected. Subsequent LFT reports were not considered for analysis, as these could have been influenced by therapeutic interventions initiated after the initial derangement (Table 1).

Google forms were drafted and were filled by the investigators. The questions consisted of both open as well as close ended questions. Demographic details like name, age, UHID number, obstetric history etc were obtained. The symptoms as well as any relevant Ultrasound findings too were noted along with the values of Serum Bilirubin Total and Indirect, SGOT, SGPT, Sr. ALP, Sr. LDH. 40 food items were included in the questionnaire and their frequency of consumption (Never, rarely (once or twice in 30 days), occasionally (once or twice a week), frequently (three to six times in a week), once daily and more than once daily was recorded. The quantity was also recorded as small portion (less than 8 ounces), medium portion (8-12 ounces) and large (more than 12 ounces). Nonvegetarian food items like meat and poultry were excluded owing to the regional dietary practices. The details of the questionnaire used for data collection is attached in supplementary files.

The data obtained was retrieved in Microsoft office excel sheets. The 40 food items were then further clubbed together based on the prominent taste or Rasa dominance of the food items. Madhura represents sweet taste, Amla(sour), Lavana (Salty), Katu (spicy), Tikta (bitter) and Kashaya (astringent). Biscuits, almonds, cashews, ice creams, cake, chocolate, mithai(Indian sweets), ripe melons, ripe pear, apple, coconut water, fruit juices, other sweets under Madhur rasa (~Sweet taste), chips, salted popcorns, salted peanuts, french fries under lavana Rasa (~Salty), cheese, curd, buttermilk, lemon, unripe mango, pickles, tamarind under Amla Rasa (~ Sour taste), bitter gourd, coffee, walnuts, dark chocolate, black tea under Tikta (~ Bitter taste), whole spices, green chilies, mustard, ginger, onion under katu (~ spicy taste), tea, dried amla, jamun, carrots, and the mud under kashay (~ Astringent taste).

The deranged LFT parameters were coded as 0 as normal and 1 as abnormal for the purpose of statistical analysis. The consumption of food items was also coded as 0 indicating insignificant consumption, 1 indicating moderate to high consumption or regular consumption. Descriptives statistics and Chi-square test, Correlation analysis, Odds ratio was used for statistical analysis of the data.

Table 1: Cut off values for deranged LFT levels.

LFT parameters	Cut off for derangement
Sr. bilirubin total (SBT)	0.8 mg/dl
Sr. bilirubin indirect (SBI)	0.6 mg/dl
Serum glutamic-oxaloacetic transaminase (SGOT)	40 IU/dl
Serum glutamic pyruvic transaminase (SGPT)	40 IU/dl
Alkaline phosphatase (ALP)	300 IU/dl
Lactate dehydrogenase (LDH)	350 IU/dl

RESULTS

The study population comprised antenatal women with at least one deranged liver function parameter, the analysis primarily reflects patterns and inter-relationships of hepatic biochemical abnormalities within an LFT-abnormal ANC cohort, rather than population prevalence. The distribution of abnormalities shows a clear hepatocellular predominance, with SGOT and SGPT derangements occurring in a large proportion of participants, while bilirubin abnormalities were comparatively less frequent. This pattern suggests that enzyme elevation predominates over bilirubin metabolism impairment during gestational hepatic stress. The detailed analysis of the results is attached in supplementary files along with this article.

Table 3: (A) Spearman correlation matrix.

Correlation matrix		SBI	SBT	SGOT	SGPT	ALP	LDH	Madhura	Amla	Lavana	Tikta	Katu	Kashaya
SBI	Spearman's rho	-											
	Df	-											
	P value	-											
SBT	Spearman's rho	0.782***	-										
	Df	99	-										
	P value	<0.001	-										
SGOT	Spearman's rho	0.191*	0.187*	-									
	Df	99	99	-									
	P value	0.028	0.031	-									
SGPT	Spearman's rho	0.242**	0.297**	0.880***	-								
	Df	99	99	99	-								
	P value	0.007	0.001	<0.001	-								
ALP	Spearman's rho	0.250**	0.259**	0.013	0.013	-							
	Df	99	99	99	99	-							
	P value	0.006	0.004	0.450	0.450	-							
LDH	Spearman's rho	0.041	0.070	0.071	0.071	0.138	-						
	Df	99	99	99	99	99	-						
	P value	0.343	0.245	0.241	0.241	0.085	-						
Madhura	Spearman's rho	0.026	0.068	-0.004	-0.004	-0.015	0.041	-					
	Df	99	99	99	99	99	99	-					
	P value	0.400	0.248	0.518	0.518	0.560	0.343	-					
Amla	Spearman's rho	0.140	0.187*	0.158	0.098	-0.046	-0.087	-0.117	-				
	Df	99	99	99	99	99	99	99	-				
	P value	0.082	0.031	0.057	0.164	0.674	0.806	0.878	-				
Lavana	Spearman's rho	-0.031	-0.005	-0.059	-0.059	-0.141	-0.164	-0.110	0.128	-			
	Df	99	99	99	99	99	99	99	99	-			
	P value	0.621	0.518	0.722	0.722	0.920	0.950	0.863	0.101	-			
Tikta	Spearman's rho	0.105	0.062	0.060	0.060	0.172*	0.015	0.033	0.060	0.084	-		
	Df	99	99	99	99	99	99	99	99	99	-		
	P value	0.147	0.268	0.274	0.274	0.043	0.442	0.371	0.274	0.202	-		
Katu	Spearman's rho	-0.098	-0.115	-0.046	-0.046	-0.070	0.036	-0.124	0.013	0.222*	-0.160	-	
	Df	99	99	99	99	99	99	99	99	99	99	-	
	P value	0.835	0.873	0.674	0.674	0.756	0.360	0.892	0.450	0.013	0.945	-	
Kashaya	Spearman's rho	0.057	0.097	0.196*	0.148	0.003	0.119	-0.034	0.148	-0.204	0.160	-0.186	-
	Df	99	99	99	99	99	99	99	99	99	99	99	-
	P value	0.286	0.167	0.025	0.070	0.487	0.118	0.634	0.070	0.980	0.055	0.969	-

*H_a is positive correlation. *p<0.05, **p<0.01, ***p<0.001, one-tailed.

Continued.

Table 3: (B) Spearman correlation matrix.

Correlation matrix		SBI	SBT	SGOT	SGPT	ALP	LDH	Madhura	Amla	Lavana	Tikta	Katu	Kashaya
SBI	Spearman's rho	-											
	Df	-											
	P value	-											
SBT	Spearman's rho	0.782	-										
	Df	99	-										
	P value	1.000	-										
SGOT	Spearman's rho	0.191	0.187	-									
	Df	99	99	-									
	P value	0.972	0.969	-									
SGPT	Spearman's rho	0.242	0.297	0.880	-								
	Df	99	99	99	-								
	P value	0.993	0.999	1.000	-								
ALP	Spearman's rho	0.250	0.259	0.013	0.013	-							
	Df	99	99	99	99	-							
	P value	0.994	0.996	0.550	0.550	-							
LDH	Spearman's rho	0.041	0.070	0.071	0.071	0.138	-						
	Df	99	99	99	99	99	-						
	P value	0.657	0.755	0.759	0.759	0.915	-						
Madhura	Spearman's rho	0.026	0.068	-0.004	-0.004	-0.015	0.041	-					
	Df	99	99	99	99	99	99	-					
	P value	0.600	0.752	0.482	0.482	0.440	0.657	-					
Amla	Spearman's rho	0.140	0.187	0.158	0.098	-0.046	-0.087	-0.117	-				
	Df	99	99	99	99	99	99	99	-				
	P value	0.918	0.969	0.943	0.836	0.326	0.194	0.122	-				
Lavana	Spearman's rho	-0.031	-0.005	-0.059	-0.059	-0.141	-0.164	-0.110	0.128	-			
	Df	99	99	99	99	99	99	99	99	-			
	P value	0.379	0.482	0.278	0.278	0.080	0.050	0.137	0.899	-			
Tikta	Spearman's rho	0.105	0.062	0.060	0.060	0.172	0.015	0.033	0.060	0.084	-		
	Df	99	99	99	99	99	99	99	99	99	-		
	P value	0.853	0.732	0.726	0.726	0.957	0.558	0.629	0.726	0.798	-		
Katu	Spearman's rho	-0.098	-0.115	-0.046	-0.046	-0.070	0.036	-0.124	0.013	0.222	-0.160	-	
	Df	99	99	99	99	99	99	99	99	99	99	-	
	P value	0.165	0.127	0.326	0.326	0.244	0.640	0.108	0.550	0.987	0.055	-	
Kashaya	Spearman's rho	0.057	0.097	0.196	0.148	0.003	0.119	-0.034	0.148	-0.204*	0.160	-0.186*	-
	Df	99	99	99	99	99	99	99	99	99	99	99	-
	P value	0.714	0.833	0.975	0.930	0.513	0.882	0.366	0.930	0.020	0.945	0.031	-

*H_a is negative correlation Note. *p<0.05, **p<0.01, ***p<0.001, one-tailed.

Table 2: Kashaya rasa and SGOT, (n=101).

SGOT	Kashaya		Total
	0	1	
0	07	14	21
1	46	34	80
Total	53	48	101
χ^2 tests	Value	Df	P value
χ^2	3.90	1	0.048

Within this selected cohort, the pattern of LFT derangement revealed a predominance of transaminase elevation, with SGOT and SGPT being abnormal in 79.2% of cases, indicating that hepatocellular enzyme derangement is the most frequent biochemical abnormality in pregnancy-associated liver dysfunction. In comparison, LDH was elevated in 31.7%, ALP in 22.8%, and indirect bilirubin in 34.7%, while total bilirubin remained within normal limits in the majority (73.3%).

Dietary analysis showed a marked dominance of Madhura rasa (~sweet taste) (95%) in the study population, reflecting prevailing antenatal dietary practices, no significant association or abnormal trend was observed between Madhura rasa intake and any LFT parameter in the study population.

The significant association between Kashay rasa (~Astringent) consumption and SGOT derangement ($\chi^2 \approx 3.9$, $p \approx 0.048$). This association was further supported by positive Spearman correlation, suggesting a selective relationship between Kashay rasa dietary patterns and hepatocellular enzyme elevation within this LFT-abnormal ANC cohort. The relatively balanced distribution of Kashaya Rasa intake enabled meaningful statistical comparison, unlike other Rasas. ALP derangement was observed more frequently among Tikta (~Bitter) consuming participants. ALP abnormality was present in 6 of 15 (40.0%) participants consuming Tikta rasa compared to 17 of 86 (19.8%) among non-consumers. Chi-square test revealed a near-significant association between Tikta rasa intake and ALP derangement ($\chi^2=2.97$, $p=0.082$). Analysis of Amla rasa (~sour taste) intake showed a higher proportion of indirect bilirubin (SBI) derangement among Amla-consuming participants compared to non-consumers. In cross-tabulation, SBI abnormality was observed in 25 of 80 (31.3%) participants consuming Amla rasa, compared to 10 of 21 (47.6%) among non-consumers. Chi-square analysis demonstrated no statistically significant association between Amla rasa and SBI derangement ($\chi^2=1.97$, $p=0.162$). Similarly, analysis with total bilirubin (SBT) showed a marginal trend, with abnormal SBT observed in 18 of 80 (22.5%) Amla consumers versus 9 of 21 (42.9%) non-consumers ($\chi^2=3.52$, $p=0.062$).

These findings support the need for targeted dietary counselling and provide a rational foundation for further integrative research combining Ayurvedic dietary principles with modern hepatic assessment.

Table 4: Tikta rasa and ALP, (n=101).

ALP	Tikta		Total
0	69	9	78
1	17	6	23
Total	86	15	101
χ^2 tests	Value	Df	P value
χ^2	2.97	1	0.085

Table 5: Amla rasa and LFT.

LFT	χ^2	Df	P value
SBI	1.949	1	0.163
SBT	3.485	1	0.062
SGOT	2.507	1	0.113
SGPT	0.965	1	0.326
ALP	0.207	1	0.649
LDH	0.752	1	0.386

DISCUSSION

Although the derangement of liver enzymes in pregnancy can be a physiological phenomenon, it can also indicate potential liver damage which is pre-existing or coincidental.[11] There can be different causes or underlying pathologies behind this derangement of liver related biomarkers.[12]

The assessment of dietary pattern of the pregnant woman can help in understanding the etiology of this condition. As per ayurveda, shad-rasa help in understanding the implications of the diet on the physiology and wellbeing of the body. The assessment of dietary pattern in terms of Shad-rasa can help in understanding the probable underlying cause of derangement of liver enzymes in pregnancy.

In the present pilot study, a notable trend was observed for the Kashay Rasa and SGOT value derangements as well as between the Amla Rasa and Serum bilirubin indirect levels and Tikta Rasa intake and ALP derangement. Dominance of consumption of sweet taste as advocated by the Acharyas was observed in the majority of the study participants.[13] This dietary pattern did not show any negative impact or association with deranged LFT parameters, suggesting its protective and balancing role during pregnancy. Excessive intake of Amla rasa, however is known to cause Rakta dushti which may be correlated with Yakrit vikriti (~ liver dysfunction) and the observed rise in Indirect bilirubin levels, reflecting impaired hepatic handling of bilirubin.[14]

Alkaline phosphatase (ALP), being synthesized in increased amounts due to placental development is physiologically elevated during pregnancy. However, when ALP elevation is accompanied by a rise in other liver

enzymes, it commonly indicates obstruction or impairment in bile flow. From an Ayurvedic perspective, excessive intake of Tikta rasa is known to cause Raukshya (~dryness) of rasa, raktadi dhatu which may contribute to impaired bile secretion and flow.[15] Similarly, Kashaya rasa is described to cause srotorodha (~obstruction in channels/vessels), leading to stagnation within the channels. Such srotorodha in the hepatobiliary system can be correlated with bile statis, which may explain the elevation of SGOT observed in such cases.[16] Although not significant these trends can help in understanding the impacts of excessive consumption on the derangement of liver enzymes. It can also help to determine whether the regulated consumption can contribute in rendering the protective effect on liver enzymes and prevent any further pathology or damage to the liver. Further studies to assess the impact of Rasa on the liver biomarkers can help in strengthening further research on formulating ideal healthy diet for pregnant women across the globe. We recommend to carry out a longitudinal large scale cohort study to reassess, validate and establish the findings.

Furthermore, a questionnaire like that of the Diet Health Questionnaire by National Institute of Health [Diet History Questionnaire III (DHQ III)] can be developed for the pregnant population to assess the potential impact of diet in pregnancy. As the dietary patterns change from region to region, questionnaires can be developed to assess the specific dietary patterns amongst pregnant women in countries like India. Similarly, study is warranted to develop a Rasa based Ayurveda questionnaire assessing the consumption pattern and impact of different Rasa with different biomarkers during pregnancy. This can be incorporated as part of antenatal care regime to facilitate the nutrition and prevent and manage different conditions in pregnancy.

Limitations

The present study was carried out as a single group pilot study with limited sample size of 100 pregnant women. Case control study can be carried out to differentiate the impact of the Rasa Sevana on those women with deranged biomarkers and those without any derangements in liver biomarkers. Recall bias, selection bias and measurement bias are inevitable in this kind of study and residual confounding due to omission or imprecise measurement of important covariates remains possible. The possibility of the impact of consumption of variable diet (quantity and quality) cannot be ruled out as well. Similarly, there is scope for the use of validated tool or questionnaire for assessment of each type of food item dependent on distinctive Rasa.

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