 DOI: 10.18231/2394-2738.2016.0004

Current epidemiological trends of the lathyrism and determinants of cropping pattern of *Lathyrus sativus* in Rewa division (M.P.), India - A time series study

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Abstract

Introduction: Lathyrism, a crippling disease, has been reported in a number of countries. The agricultural record shows that the production of *L.sativus* has neither decreased nor appreciably increased and continue the same as it was 3 to 4 decades. While it not had been information on major outbreak of lathyrism in this period, however sporadic cases have been reported from time to time as per available previous data.In recent times, the problem has acquired new dimensions, which hold out possibilities of wider dissemination of the disease. It was probably true that the consumption of Lathyrus seeds had dropped during recent times, but this was probably because other crops like wheat, barley, lentils and Bengal gram had flourished.

Material & Method: The current study was conducted during study period April 1980 to March 1982. In order to study the recent trends of lathyrism, the same area and technique have been adopted as were follow by Ganapathy & Dwivedi and Dwivedi and Prasad. Revisit to study the same area where detail epidemiological work was carried out and reported by Dwivedi & Prasad. They were the 18 village of Rewa and 10 village of Satna districts. The other part of study included the collection of information of occurrence of cases occurred during the last 10 years period. The area of survey restricted to Rewa division to determine those factor responsible for secular variations in the prevalence of disease from the previous I.C.M.R. study. This another part of the study was related to study the economic market forces and cropping pattern in relation to production, distribution and consumption of Khesari in these areas under study. Data was compiled in MS excel and checked for its completeness and correctness then it was analyzed.

Observations: There were 55 villages in the three districts from where 118 fresh cases were recorded. It is evident that disease is prevalent being 16% in Rewa, 66% in Satna and 33% in Sidhi districts. The yield and the market price trend in the last ten years in Madhya Pradesh nearly maintained the production of L. sativus nearly but there has been increasing trend in price structure of pulse from Rs.47/- to Rs. 300/- per quintal in the year 1964-65 to 1988-81. In the present study cases of lathyrism were not reported from any village from district Shahdol. The rainfall is quite adequate. Due to this the agriculturist did not care to develop artificial means of irrigation and as such are still depend upon annual rainfall. If there is weak correlation coefficient between prices and number of cases.

Recommendations: Health education has to be carried out through appropriate mass media to educate people about the menace of consumption of Khesari dal. It is also necessary that payment of Khesari dal in any form and proportion to the agricultural laborers should be banned henceforth. In area where Khesari is cultivated as an insurance crop to safe guard against drought development of irrigation facilities have to be taken on priority basis.

Keywords: Lathyrism, L. sativus, Khesari dal, Rewa.

Introduction

Lathyrism, a crippling disease, has been reported in a number of countries. It has been prevalent among horses and cattle as well. In man the symptom usually manifest suddenly and is usually precipitated by exposure to rainy environment and overwork. The underlying physiological significance of this environment is not clear, so this clinical entity cantani of Italy called Lathyrism.

Studies during the last decade have indicated that B-N-Oxalyl-L- a, b –diamino propionic acid, the neurotoxin (O.D.A.P.) isolated from L.Sativus seeds, is probably the chief toxic factor responsible for the manifestation of the disease. Extensive studies have led to the recognition that lathyrism in human beings, which is characterized by spastic paralysis of legs as a result of neurological lesions of the spinal cord degeneration is quite different from the skeletal abnormalities induced in experimental animals by feeding L. odoratus or B-aminoproionitril (BAPN).[1,2,3]

The Nutrition foundation of India sponsored a project to assess the present position of this disease. The agricultural record shows that the production of L.sativus has neither decreased nor appreciably increased and continue the same as it was twenty five years. While it not had been information on major outbreak of lathyrism in this period, however sporadic cases have been reported from time to time. It was also pointed out that cost pattern of lathyrism has undergone rapid changes varying from 53/quintal to about Rs. 250/-quintal (1953 to 1981). Is this factor an important issue?[4,5,6,7]

In recent times, the problem has acquired new dimensions, which hold out possibilities of wider dissemination of the disease. It was probably true that the consumption of Lathyrus seeds had dropped during

recent times, but this was probably because other crops like wheat, barley, lentils and Bengal gram had flourished.[8] With this changing background and the conflicting reports, the present study has been undertaken with a modest desire to ascertain the current prevalence of the disease and other connected factors in the districts of Rewa and Satna.

Material & Method

The current study [Qualitative &Quantitative both] was conducted during study period April 1980 to March 1982. In order to study the recent trends of lathyrism, the same area and technique have been adopted as were follow by Ganapathy & Dwivedi (1961) and Dwivedi and Prasad (1964).[9,10] Revisit to study the same area where detail epidemiological work was carried out and reported by Dwivedi& Prasad (1964). They were the following 18 village of Rewa and 10 village of Satna districts.

Villages of Rewa District: Panasi, Jivla, Kostha, Lawa, Girui, Majan, Bakchera, Roura, Pallia, Kuinya, Ratehari, Mahuli, PalliaKothar, Patna, Pipari, Shukli, Dhekare, Ratehra

Villages of Satna District: Pipari, Harduwa, Karra, Ganga Sagar, Bhitari, Ganjas, Ramnagar, Chorahata, Dudha, Kotar.

The other part of study included the collection of information of occurrence of cases occurred during the last 10 years period i.e. case occurring from 1975 to 1982.

The area of survey restricted to Rewa division to determine those factor responsible for secular variations in the prevalence of disease from the previous ICMR study spread over a period of 1956 – 1961 (Ganapathy & Dwivedi. 1961).[9] The following survey protocol was adopted.

1. The family was the unit of approach for detecting establishes form of lathyrism cases. All members of families of the selected village wore examined for details clinical features of the disease with history of consumption of Khesari dal (*L. Sativus*).
2. Name, age, sex and relationship in respect of the head of the family were recorded.
3. All the inmates of a house were examined. The examination of the complete nervous system in general and paraplegia in particular was done. The gait of the patient, which is spastic and scissors in character, was observed and recorded carefully for the differential diagnosis and classification of the forms and stages of the disease.
4. Subjects showing positive neurological signs were interrogated as to their complaints, sequence of the development of the disease audits relation with the food they take and a pretested proforma was filled for vital information.

In 28 villages selected having a total population of 24,423. 177 persons were found to have positive neurological signs of lathyrism with definite history of consumption of L. sativus. Only the established form of disease was investigated. The latent form of disease was not investigated. The established form directly affects the man power and in major public health problem. In the remaining fifty five villages the study was mainly of the nature of case study. Here whenever report of recent occurrence of cases was received, the village was visited not only to verify the rumor, but also on spot study of other cases of lathyrism was enquired out from the villages.

This third part of the study was mainly related to study the economic market forces and cropping pattern in relation to production, distribution and consumption of Khesari in these areas under study. Interrogating village head, ponny's trader, the traders in mendi flouring dal mills and transporter.

There have not been major out breaks of disease in post two decades in this region. Sporadic small out-breaks however have been reported off and on in this area. It was in general impression that there was a decline in prevalence of disease. The record of cultivation of Khesari dal shows that it is neither decreased nor appreciably increased. This created a baffling situation as to why the disease has declined even when the production has not in dock, and stimulates many thoughts. Whether the disease has actually declined or whether it show what is happening to Khesari dal. It was also assumed that a major part of production is siphoning from the area, it is being largely used an adulterant through red gram and basin and is being sold in market either as such or in the form of various preparation. It was also fear that such situation continues that might be extension of disease from rural area to urban area. All these questions are related to the agrodyanamic and market forces which is operation upon. Hence, this study has been under-taken in region.

Data was compiled in MS excel and checked for its completeness and correctness then it was analyzed.

Observations

In order to study the current trends of lathyrism information of occurrence of fresh cases from 1978 to 1982 was collected from neighboring villages, other than previously mentioned 28 village of Rewa and Satna districts. These 55 villages belong to district Rewa, Satna and Sidhi. The method of collection of information was through self-reporting, from hospital record and through medical officer of primary health centers and also through rumor from many other sources. All these information were verified by actual visit. The fresh reported cases were verified for the year of onset, dietetic variation and clinical manifestations. (Establish form of disease). Their addresses have been recorded in pre-structured proforma.

Table 1: Year wise occurrence of fresh (1978-1982) cases with their sex wish prevalence distribution

District	Village	Population (Census, 1971)	No. of new cases of lathyrism occurring year wish in village						Sex wise distribution		
			1978	79	80	81	1982	Total	Male	Female	%
Rewa	38	47201	15	4	27	27	4	77	73	4	0.16
Satna	8	2988	-	1	13	3	3	20	16	4	0.66
Sidhi	9	6296	5	4	6	6	-	21	21	-	0.33
Total	**55**	**56485**	**20**	**9**	**46**	**36**	**7**	**118**	**110**	**8**	**0.20**

Table 1 shows that there were 55 villages in the three districts from where 118 fresh cases were recorded. The population of village and number of cases recorded in years 1978 to 1982, given detail of occurrence of fresh cases within of five years in 55 villages of Rewa, Satna and Sidhi district. It can be seen that cases are regularly occurring in these districts. These cases could never have been reported but for this type of study. This indicates that it is false notion that disease with die on its own death it is defective monitoring system, cases remain hidden in rural area. It is evident that disease is prevalent being 16% in Rewa. 66% in satna and 33% in Sidhi districts.

Maps of district Rewa, Satna and Sidhi indicate that out of total 55 village only 12 (12.8%) village situated on road side were affected, while majority being 43 (78.2%) were situated far from the main township. This is a very important finding since. Siphoning of Lathyrus Sativus is difficult from remote villages, where it is largely consumed by the poor class of people.

Table 2: The area under pulse *L. sativus* crop in M.P.

Year	Area under cultivation / 1000 Hectare	Production in/ 1000 Met. Tones	Price per quintal in Rs.
1964-65	694	289	47.03
1965-66	493	136	55.46
1966-67	410	105	86.76
1967-68	570	79	77.30
1968-69	569	193	50.67
1969-70	577	188	54.84
1970-71	706	313	46.08
1971-72	748	364	50.20
1972-73	744	283	83.08
1973-74	829	305	125.63
1974-75	520	213	109.30
1975-76	797	353	60.58
1976-77	679	141	107.03
1977-78	773	309	119.82
1978-79	782	269	105.07
1979-80	470	76	145.37
1980-81	631	189	273.00

Source: Based on Commissioner land records. M.P.

Table 2 showing the area under pulse L. sativus crop. The yield and the market price trend in the last ten years in Madhya Pradesh nearly maintained the production of L.sativus nearly but there has been increasing trend in price structure of pulse from Rs.47/- to Rs. 300/- per quintal in the year 1964-65 to 1988-81.

Table 3 gives details of Khesari dal cultivation Rewa division from 1965 to 1980. Except for the district Shahdol the cultivation is popular in the remaining district for Rewa. Satna and Sidhi. In the present study cases of lathyrism were not reported from any village from district Shahdol.

Table 3: The Year wise cultivation and production in the four districts of division Rewa

Year	Rewa		Satna		Sidhi		Shahdol	
	Cultivation in Hector	Prod. in Tons	Cultivation in Hector	Prod. in Tons	Cultivation in Hector	Prod. in Tons	Cultivation in Hector	Prod. in Tons
1965	8687	1037	2810	414	4303	593	64	9
1965-66	7422	1902	2072	644	1887	368	76	19
1966-67	6279	527	3240	713	575	75	119	12
1967-68	2707	599	1696	343	1390	388	34	9
1968-69	5690	192	NA	NA	NA	NA	NA	NA
1969-70	2072	847	1966	774	1061	326	306	74
1970-71	3126	1133	2483	993	1218	621	163	48
1971-72	3128	851	2214	614	1459	381	155	43
1972-73	3438	1596	2450	1201	1297	568	186	80
1973-74	6689	1935	4881	1451	1884	516	197	68
1974-75	7027	1885	6157	1496	2211	588	181	40
1975-76	7504	3663	4090	1390	2259	881	295	115
1976-77	8162	2082	5087	1265	1971	438	166	41
1977-78	6488	2429	3682	1285	2211	755	782	88
1978-79	6700	2500	3700	2000	080	020	020	01
1979-80	7700	1100	4600	0600	1600	0100	0100	-

Source: By Director of Land Records/Agriculture Office, Rewa.

Table 4: Rainfall in studied area (Rewa division)

Year	Rain Fall in MM			
	Rewa	Satna	Sidhi	Shahdol
1971-72	1801	1590	1437	1441
1972-73	1161	1022	1037	1140
1973-74	797	784	862	884
1974-75	837	797	821	801
1975-76	1306	1473	1205	1749
1976-77	1905	967	906	991
1977-78	1012	1022	1502	1488
1978-79	1455	1303	1142	1178
1979-80	655	501	467	627
1980-81	1539	1573	1396	1504
1981-82	1204	899	1159	807

Table 4 shown an average annual rain fall for the years 1971-1972 to 1981-1982. The rainfall is quite adequate. Due to this the agriculturist did not care to develop artificial means of irrigation and as such are still depend upon annual rainfall.

The formula to find out co-efficient of correlation is given by n

$$y\,xy = \frac{\sum \quad (\mathrm{xi} - \mathrm{x})(\mathrm{y} = \mathrm{y})}{\sqrt{-\sum(\mathrm{xi} - \mathrm{x})2}\sum(\mathrm{yi} - \mathrm{y})2}$$

Where y xy is the correlation co-efficient between variables and y.

Table 5: Association of lathyrism with climatic conditions (1970 to 1980)

Association of Lathyrism	Year (1970 to 1980)									
	70-71	71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79	80
Annual Rainfall in mm (Rewa Division)	1201	1801	1163	797	837	1306	905	1012	1455	655
Production of lathyrus in met.tons (state level)	313	364	283	305	213	355	141	309	269	77
Price rate of lathyrus per quintel (Farm Harvest)	46.08	50.20	83.08	125.63	109.30	60.58	107.03	119.82	112.0	145
No of cases of Lathyrism in 28 vill-ages of Rewa and Satna	8	-	3	-	1	11	2	11	14	6

Correlation, coefficient: (a) the correlation between rainfall and number of cases in the next year is –438. The negative correlation indicates that whenever there is scanty rainfall the numbers of cases are on increase. (b) The correlation coefficient between price of lathyrussativus and number of cases is -0.088 which is reasonably a weak correlation and is in conformity with the pattern of consumption in the villages. The reason is that when there is drought the wheat ever lathyrussativus in produced it is used locally by the villager for their own consumption or for paying wages. It is not sold in the market for earning purposes. Only the surplus amount comes in the market which affects prices. Since the consumers do not by the L-sativus but they consume. If there is weak correlation coefficient between prices and number of cases(Table 5).

Table 6: Trading pattern Khesari Dal in the study area

S. No.	Town/ village	Code names of the traders
1.	Ram Nagar	K.B.
2.	Conjas	G
3.	Ramnagar	B
4.	Rewa	C.R.
5.	Rewa	P.C.G.
6.	Rewa	S/K
7.	Rewa	R/B
8.	Rewa	R/G
9.	Rewa	D/C
10.	Chakghat	S/L
11.	Rewa	D/B
12.	Satna	R.G.
13.	Satna	B/K
14.	Satna	C/K
15.	Satna	R/A
16.	Satna	A/M
17.	Satna	I/K
18.	Satna	K/K
19.	Satna	G/M
20.	Katni	K.P.
21.	Katni	B.P./K
22.	Katni	B.M.S.
23.	Katni	M.M./P.R.
24.	Katni	M.D./G.

It was endeavored to study the trading system of lathyrussativus. The various persons interviewed included grain merchants, petty shop keepers who were practicing barter system also, traders collecting grains from village to village on bullock carts or pennies etc. after collecting lathyrus, the village traders sale it to the nearest whole sale grain market (Mandi). The whole sale traders either send the pulse to mill (Dal mill) for dehusking and lathyrus flour were utilized for adulterating various raw food articles e.g. red gram pulse. Bengal gram, flour (besun) which is used for various preparations like 'bhajiya' 'papad' etc. It was not possible to find out names of all the whole sale grain merchants and 'Dal mill' owners who were involved in 'Khesari dal' (Lathyrus) trade, however, enquiries revealed that most of them had stock of lathyrus, a part from other grains. Some family member of the majority of such merchants was also owing a 'das mill' examples of a few traders who are involves in the 'Khesari dal' trader are given in above table(Table 6).

Discussion

The Government of India prohibited the sale of Khasari, or its product in its pure and in the form of 'Birri' (Mixture) under Rule 44 of P.F.A. Act. (1968). With meager information available it was not possible to confirm any recent epidemiological trends of lathyrism. The consumption of lathyrus seeds came down because of harvesting of other pulses. The cost pattern of Lathyrussativus had undergone changes, varying from Rs. 53/- per quintel in 1953 to about Rs. 250/- per quintal in the year 1981. This factor is an important issue. There is a marked difference in current price of pulse as compared to previous one. After 1961 study, no systematic authentic survey was undertaken to say whether the prevalence of lathyrism had gone down or was the same. The production of Khesari has not been reduced as seen from the finding of the current study, but the disease appeared to have been reduced. If it is true, then was it due to changes in socio-agricultural aspects or some other market forces, which might have been taking away Khesari from the rural poor labor class to some other areas, or was the disease still occurring, though not in major epidemic form, but in sporadic and in the form of small out breaks.

The present study showed the secular trends including influence of agro-market forces in relation to lathyrism. A study in cultivation pattern has revealed that the cultivation of L. sativus has declined from 8687 hectare in 1965 to 6700 hectare in 1979 in Rewa district and 4303 hectare to 80 hectare in Sidhi district and 64 to 20 hectare in Shahdol district. While increase have been observed from 2810 hectare to 3700 hectare in Satna district. A marked increase in the entire district in cultivation area was seen during drought year of 1979-1980. The decline was not gradual and did not set a trend but was fluctuating and has risen even 5 times more one year to the other.[11]

The price of L. sativus has markedly increased from Rs. 46/- to Rs. 300/- quintal from 1970 to 1981, but its cost is far less as compared to other pulses which vary from Rs.500/- to Rs. 600/- per quintal. Thus L. sativus is used for adulteration. A study recording market trends by interviews the villagers, agriculturists, traders operating on ponies, local traders, petty shop keepers, transporters have revealed that L. sativus apart from being given in lieu of wages to laborers is also brought

to Mandi. In Mandi it is purchased by transporting grain traders, local traders (grain market shopkeepers) dehusk and make its four in 'dal' mills and sole it to shopkeeper from where it in the form of 'dal' basin' namkeen' and also as adulterant to the other pulses with the cheap L. sativus. The transporters on the other hand send the pulse to big Mandi in this state also to other status even when there is ban.[12,13]

The awareness has been greatly contributed by the press in 1982. People have gone to the Supreme Court for complete ban of the crop. The Supreme Court even ordered the local administration of Satna and Rewa. The findings of the local administration and the present study are more or less similar. The study thus has revealed that in this area the siphoning of lathyrus from rural to urban, though is being practiced but L. sativus is still relined in the rural area, more so during drought year. It is still being used as a system of payment to the laborer. The decline in the prevalence has been mainly due to awareness, but still in lieu of scarcity people forget the malady in the efforts to save themselves from the pangs of starvation. It can be concluded that for eradication of lathyrism, the cultivation has to be stopped all together. This has to be a gradual and guarded process so that the sufferer may not suffer more either from diseases of from starvation. The current epidemiological trends of lathyrism were studied in previously surveyed 28 villages and in other 55 villages of Rewa, Satna and Sidhi districts through collection of information from various sources. Out of total population of 56,485 of the 55 villages in 3 districts 118 fresh cases occurred with last five years (1978 to 1982). The prevalence rate works out to be 2.07/1000 population for the fresh cases.

The area for cultivation of L. sativus in Madhya Pradesh is almost constant from 1964 to 1981 and production is also constant ranging from 200 to 300 thousand wet, tones. The price was found gradually increasing. It was 47.03/quintal in 1964 while it becomes Rs. 273/- quintal in 1980-81. In Rewa division there is not much difference in production of crops and cultivation area from 1965 to 1980.

The average annual rainfall in Rewa division has been recorded as 1131.9mm. No wide variations except for drought year in the rainfall in other districts of the division were observed.[14] Due to the gradually increasing market value the Lathyrussativus was sold in the market and being a cheaper legume, there were every chance for its adulteration with the other pulses viz., Bengal gram and Red gram. The petty farmers retain the seeds of L. sativus for consumption while the big farmers retain the production during the years of drought to pay their laborers in the form of wages.

Till date there is no uniform reporting unit nor the disease is reported by the department of public health. There is lack of awareness and misconceptions amongst the population regarding the disease. Majority of patients believe that it was due to evil winds and curse of God. The occurrence of cases are directly associated with rainfall. As and when there is scanty rainfall, the number of cases increases in the following year. The scanty rainfall does not have any adverse effect on the production of Lathyrussativus. There is constant increase in the marketing value of the crop.[15,16]

Recommendations

Short Term Measures: Health education has to be carried out through appropriate mass media to educate people about the menace of consumption of Khesari dal. Rule 44 A of the Preventive of Food adulteration Act, should be enforced to restrict the sale of Khesari all over the country. It is also necessary that payment of Khesari dal in any form and proportion to the agricultural laborers should be banned henceforth. It can also be made a punishable offence under section 328 I.P.C. Khesari dal is largely used for adulteration of 'Basen' and 'Tuaur dal', therefore Public Health laboratories should be strengthened for detection of adulteration with Khesari dal.

Long Term Measures: In area where Khesari is cultivated as an insurance crop to safe guard against drought development of irrigation facilities have to be taken on priority basis. On the other hand in rice growing areas where it is cultivated as an important winter crop, pattern of cropping have to be changed to replace Khesari by other winter crops. Owing to unstable nature of Pusa-24, a law toxic variety of Khesari, it seems difficult to evolve a toxin free strain of Khesari in near future. Khesari cultivation in Madhya Pradesh in maintained more or less constant in terms of area under cultivation and production in tons. The market price of the pulse is increasing. In rural areas its price is as low as Rs. 120.00 per quintal, but in the urban market price varies from Rs. 250.00 to Rs. 300.00 per quintal. The pulse is known to be utilized to adulterate 'Besan' Bengal gram flour and 'Arhar' dal. Hence, the possibility of shifting of lathyrism from rural to urban and from affected to unaffected areas cannot be ruled out.

Strength of the present study: Many factors like Agricultural, Economical, Meteorological, Market trading patterns and utilization of pulse for food adulteration were studies in the present study which was not done in previous studies. The finding of the present study will be useful for future research and prevention of adulteration of L. sativus with other pulses.

Acknowledgement

Authors are thankful to honorable guide Late Dr. M. P. Dwivedi (Previous Prof. & HOD, Department of Community Medicine, SSMC, Rewa (M.P.) and Mr. Prabhakar Singh (Agriculturist, Rewa) for their valuable guidance and technical support for the study. The authors are also thankful to Dr. C. Gopalan (Pervious Director, Nutrition foundation of India, New Delhi) for their financial assistance.

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