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Prevalence of non-communicable diseases among camel milk consumers and non-consumers tribal population aged more than equal to 30 years in rural Rajasthan: A community-based cross-sectional study

Vaishali Soni[1], Pritam Halder[1]

[1]Department of Community Medicine and School of Public Health, Post Graduate Institute of Medical Education and Research, Chandigarh, India.

***Corresponding author:**
Pritam Halder,
Department of Community Medicine and School of Public Health, Post Graduate Institute of Medical Education and Research, Chandigarh, India.

rynedann@gmail.com

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ABSTRACT

Objectives: There is an ongoing trend of increasing burden of non-communicable diseases among the tribal population. The objective was to determine the prevalence of non-communicable diseases among camel milk consumers (CMC) and non-consumers tribal population aged ≥ 30 years in rural Rajasthan.

Material and Methods: A community-based cross-sectional study was conducted among 60 adults CMC aged >30 years from the Riaka tribe. Same number of non-camel milk consumers (NCMC) were recruited with respect to similar age, gender, and residence from the same tribe. After obtaining informed consent, a semi-structured interview schedule containing sociodemographic dietary characteristics was introduced to all participants in June 2013. The participants were assessed for their random blood glucose, blood pressure, and lipid profile. Data was entered into Microsoft Excel version 2013 and analyzed in Stata version 13.

Results: Among all, 26.6% male and 23.3% female NCMC participants were found to be suffering from diabetes and in CMC male participants, only 3.3 % were found to be suffering from diabetes. The mean standard deviation (SD) random blood glucose level of CMC and NCMC participants was 98.67 ± 8.81 and 115.50 ± 28.12 mg/dL for male participants and 95.93 ± 5.17 and 110.50 ± 35.22 mg/dL for female participants, respectively, with significant statistical differences. Stage-I hypertension (HTN) was reported in only NCMC male participants, which are further classified as systolic and diastolic stage-I HTN in 4 % and 2% participants, respectively. No cases of stage II HTN were observed. Mean (SD) systolic blood pressures (mmHg) were more in NCMC (122.36 ± 7.67) than CMC (118.84 ± 5.81) female participants with a statistically significant difference ($P < 0.05$). In this study, we found that total cholesterol, low-density lipoprotein levels were less, and high-density lipoprotein level was more in CMC compared to NCMC irrespective of gender.

Conclusion: The prevalence of non-communicable diseases was relatively less in CMC than NCMC irrespective of gender, suggesting the beneficial effects of camel milk consumption. It is advised that additional research be conducted in the future.

Keywords: Non-communicable disease, Diabetes, Hypertension

INTRODUCTION

Most diseases and fatalities worldwide are caused by cardiovascular disease (CVD) disorders due to the epidemiological change over the past three decades.[1,2] An increase in the burden of non-communicable diseases (NCDs) has replaced the dominance of communicable (infectious)

diseases as a result of rapid economic growth and subsequent development.[3] Although NCDs have been on the rise in India's more developed states for some time, significant rises are now being seen in the country's less developed areas as well.[4-6] Tribal communities frequently live apart from urban areas in different locations and keep moving frequently. They are reluctant about their health conditions.[7] Unnoticeably the prevalence of NCD is rising in this population.[8]

India had a 9.3% prevalence of diabetes. In rural settings, 5.7% males and 8.1% females between the ages of 18 and 69 had diabetes, according to the National Nutrition Monitoring survey (2017–2018).[9] According to National Family Health Survey-5 (2020–21), the prevalence of diabetes was 1.8% in males and 2.3% in females in Rajasthan.[10]

As per the National Non-communicable Disease Monitoring Survey, the prevalence of hypertension (HTN) was 24.9% in India. Among all, 22.8% males and 21.8% females were hypertensive.[9] Asians, particularly Indians, have been found to have atherogenic dyslipidemia with greater rates of low high-density lipoprotein (HDL) cholesterol and high triglycerides and lower rates of high blood cholesterol than non-Asian populations.[11,12]

Camel milk containing high amount of insulin or insulin such as peptides (52 u/L) lactoferrin, immunoglobulin, peptidoglycan recognition protein, and lactoperoxidase helps to decrease blood sugar level.[13] There is a scarcity of data regarding the prevalence of NCD among camel milk consumers (CMC) and non-consumer tribal populations aged >30 years in rural Rajasthan. Hence, we conducted the present study.

MATERIAL AND METHODS

The participants in this study were Raikas, a camel-rearing tribal community living in the villages of Palana, Morkhana, and Udasar in rural Bikaner, Rajasthan. Taking prevalence of diabetes among adults in tribal Rajasthan as 5.2%, absolute precision as 6%, alpha as 95%, and non-response rate as 10%; the estimated sample size was 60.[14]

A list of CMC was prepared with the help of local panchayat personnels. A pilot study was carried out in the village of Bhamatsar. For the original study, 30 male participants were recruited by simple random sampling. Same number of females were selected from the same household meeting the eligibility criteria, that is, participants who have been ingesting camel milk (at least 500 mL) every day for the past 1 year. Participants who had undergone a blood transfusion within the previous year, and had a history of piles, anal fissures, hematemesis, malaria, hemoptysis, or severe blood loss were excluded from the study.

Sixty non-CMCs in the same age and gender residing in similar rural settings were recruited. All the participants were introduced to a semi-structured interview schedule covering sociodemographic, anthropometry, and nutritional characteristics in June 2013 after taking their informed consent.

The objective was to determine the prevalence of NCDs among CMCs and non-consumers tribal population aged ≥ 30 years in rural Rajasthan.

Diet

The recommended serving seizes were as follows: protein 15.20–30.25 g, green leafy vegetables 22.40–35.10 g, roots and tubers 96.50–200.10 g, other vegetables 22.40–38.4 g, fruits 10.40–25.75 g, milk and milk products 30.50–450 g, fat and oils 8.10–30.75 g, and sugar and jaggery 9.50–30.30 g.[10]

Random blood glucose (Random blood sugar, RBS)

RBS measures blood glucose regardless of when we last ate. Random testing is useful because glucose levels in healthy people do not vary widely throughout the day. Normal random blood sugar level should be <200 mg/dL.[15] A standardized digital glucometer (Accu-Check, Roche Diagnostics, Germany) was used to assess random blood sugar levels from capillary blood obtained through finger pricking method.

Blood pressure (BP) measurement

The diastolic and systolic blood pressures (DBP and SBP) were assessed, as HTN is the major risk factor of CVD. BP is defined as the lateral pressure exerted by the blood on the vessel walls while flowing through it (Chattarjee, 1976).[16] The measurement of pressure is made in relation to the heart's pumping activity and is measured in millimeters of mercury (mmHg). The size of the cuff was determined by measuring the arm circumference. On the same arm, BP was measured 3 times with a typical digital sphygmomanometer (Portable Omron BP monitor, model HEM 8712), with a minimum 5-min gap between each reading. Before beginning the first reading, participants were instructed to sit and unwind for at least 5 min. At equal intervals, three systolic and diastolic measurements were taken. The final reading for our investigation was determined to be the average of the three values. JNC 7 criteria (SBP 140 mmHg and DBP 90 mmHg) were used to identify high BP.[17]

Lipid profile

Lipid profile covers serum cholesterol, serum triglyceride lipoprotein, that is, low-density lipoprotein (LDL), HDL, and very low-density lipoprotein (VLDL) cholesterol. Five mL blood sample was taken from willing participants under aseptic conditions. CHOL-CHOD POD method was used for estimation of total cholesterol, HCHO-selective immune precipitation method was used for HDL-cholesterol (HDL-C),

and enzymatic colorimetric method (GPO) for triglyceride and others (LDL, VLDL, total serum cholesterol (TC)/HDL ratio, and LDL/HDL ratio) were calculated as per process adopted by Thyrocare Technologies Ltd. using "lipo-photometry analyzer." Blood specimen was allowed to clot for 30 min at ambient temperature. Then, it was centrifuged at 1,000 rpm for 10 min to remove residual blood cells, transferred to bar coded serum vial, labeled, and secured the cap tightly.

Statistical analysis

Data was collected in the interview schedule and entered into Microsoft Excel version 2013 and analyzed in Stata version 13 (Stata Corp. 2013. Stata Statistical Software: Release 13. College Station, TX: Stata Corp LP.). Characteristics of participants were described as mean (standard deviation) for continuous variables frequencies and percentages for categorical variables. Chi-square statistics were used to compare against various groups. Prevalence was calculated. $P < 0.05$ was considered statistically significant.

Ethical clearance

The ethics committee at Swami Keshwanand Rajasthan Agricultural University, Bikaner, granted its approval, approval number: IEC SKRAU-70.

RESULTS

Demographic and socioeconomic details

Most participants (68%) in both groups were between the ages of 40 and 50 years. Mean standard deviation (SD) age (years) was 42.1 (17.2) and 42.8 (16.8) in CMC and NCMC groups, respectively. Their education ranged from primary to graduate level; nevertheless, 62% from CMC and 48% from NCMC group participants were found to be illiterate, while 4% and 10% from CMC and NCMC group participants, respectively, had degrees. For both the CMC and NCMC groups, the proportion of participants who belonged to joint families was 89% and 78%, respectively. Families in pucca houses make up only 20% and 25% of both categories.

Diet

Due to its accessibility, medicinal benefits, and historical household usage, all participants consumed camel milk. While 68% of participants drank it because it was inexpensive, and 70% did so due to the excellent nutritional value of camel milk. Each participant in the study had their dietary information collected. All individuals were found to be consuming a high amount of grain (Bajra) between 350 g and 600 g and a moderate amount of pulses, according to the findings of food consumption. All of the participants were found to be inadvertently consuming insufficient amounts of pulses, green leafy vegetables, other vegetables, fruits, milk, milk products, fat, sugar, and jaggery. When compared to the ICMR's recommended intake, it was found that the consumption of cereals, roots, and tubers was insufficient.[18]

The mean (SD) height, weight, body mass index, and waist-hip ratio of the CMC and NCMC male participant were 176.32 ± 3.24, 176.34 ± 3.16 (cm); 67.56 ± 5.75, 69.38 ± 6.48 (kg); 21.70 ± 1.39, 22.26 ± 1.57 (kg/m^2); and 0.886 ± 0.021, 0.887 ± 0.178, respectively, and the counterpart values for CMC and NCMC female participant were 158.60 ± 3.97, 158.68 ± 4.94 (cm); 54.02 ± 4.29, 53.98 ± 4.49 (kg); 21.47 ± 1.54, 21.37 ± 1.52 (kg/m^2); and 0.774 ± 0.020, 0.774 ± 0.020, respectively, with non-significant difference between both the groups.

Blood glucose level of the participants

Under this study, 26.6% male and 23.3% female NCMC participants were found to be suffering from diabetes and in CMC male participants; only 3.3% were found to be suffering from diabetes [Table 1].

The mean (SD) RBS level of CMC and NCMC participants was 98.67 ± 8.81 and 115.50±28.12 mg/dL for male participants and 95.93 ± 5.17 and 110.50 ± 35.22 mg/dL for female participants, respectively. The result clearly indicates a statistically significant difference between NCMC and CMC participants for their RBS values in both males and females. Although all the participants had their mean RBS values below the reference value, the CMC participants had significantly lower random blood sugar value as compared to their NCMC counterparts [Table 2].

BP

It was found that 52% of CMC and 42% of NCMC male participants had normal SBP and 56% CMC and 50% NCMC male participants had normal DBP. Likewise, 58% CMC and

Table 1: Distribution of participants with respect to random blood glucose level.

Parameter	Suggested value (mg/dL)	Male		Female	
		CMC (*n*=30) *n* (%)	NCMC (*n*=30) *n* (%)	CMC (*n*=30) *n* (%)	NCMC (*n*=30) *n* (%)
Normal	<200	29 (96.7)	22 (73.4)	-	23 (76.7)
Hyperglycemia	>200	1 (3.3)	8 (26.6)	-	7 (23.3)

CMC: Camel milk consumers, NCMC: Non-camel milk consumers

54% NCMC female participants had normal SBP, while 58% and 56% female participants had normal DBP in CMC and NCMC groups, respectively.

A category named pre-hypertension characterized by SBP ranged between 120 mm and 139 mmHg or DBP range between, 80 mm and 89 mmHg has been introduced by JNC and in actual, is not a disease category, rather a designation chosen to identify individuals at high risk developing HTN so that both patients and clinicians are altered to this risk and encouraged to intervene and prevent or delay the disease from developing. In the present study, systolic pre-hypertension was found in 8% CMC and 14% NCMC male participants, whereas a diastolic pre-hypertension state was found in 4% CMC and 8% NCMC male participants. A systolic pre-hypertensive condition in 2% CMC and 6% NCMC female participants was also noted. Likewise, 2% and 4% female participants were reported in a diastolic pre-hypertensive condition in CMC and NCMC groups, respectively.

Stage-I HTN was reported in only NCMC male participants which are further classified as systolic and diastolic stage-I HTN in 4 % and 2% participants, respectively. No cases of stage II HTN were observed [Table 3].[17]

Mean (SD) SBP (mmHg) was 119.22 ± 11.33 and 122.46 ± 15.19 in CMC and NCMC male participants, respectively, with no statistically significant difference between them. Mean (SD) DBP (mmHg) was 78.76 ± 7.01 and 81.16 ± 8.53 in CMC and NCMC male participants, respectively, with no statistically significant difference.

Mean (SD) SBP (mmHg) was more in NCMC (122.36 ± 7.67) than CMC (118.84 ± 5.81) female participants with a statistically significant difference ($P < 0.05$). Mean (SD) DBP (mmHg) was more in NCMC (80.32 ± 4.84) than CMC (77.88 ± 5.17) female participants with no statistically significant difference [Table 4].

Lipid profile

Total cholesterol

Based on recommendations of the National Cholesterol Education Program and National Institute of Health consensus statements, serum cholesterol levels in the ranges below 200, 200 to 240, and above 240 mg/dL are considered as "desirable," "borderline high" and "high risk," respectively. The mean (SD) cholesterol level (mg/dL) of the participants of NCMC (170.57 ± 15.70) was higher than CMC (169.77 ± 9.68) group for male participants. Similarly, the mean (SD) cholesterol level (mg/dl) of the participants of NCMC (164.50 ± 8.09) was higher than CMC (162.07 ± 8.10) group for female participants. There was a non-significant statistical difference between these groups for both male and female participants [Table 5].

LDL cholesterol

The mean (SD) LDL level was noted to be 93.93 ± 7.46 mg/dL, 88.10 ± 5.75 mg/dL, 97.48±17.5 mg/dL, and 91.53 ± 7.49 mg/dL for CMC and NCMC male and female participants, respectively [Table 5]. No significant statistical

Table 2: Distribution of the participants with respect to their mean+SD blood glucose level of the participants.

Parameter	Male		*P*-value	Female		*P*-value
	CMC (*n*=30)	NCMC (*n*=30)		CMC (*n*=30)	NCMC (*n*=30)	
Blood glucose (mg/dL)	98.67±8.81	115.50±28.12	0.003	95.93±5.17	110.50±35.22	0.03

SD: Standard deviation, CMC: Camel milk consumers, NCMC: Non-camel milk consumers

Table 3: Classification of participants with respect to blood pressure levels (JNC 7).

Blood pressure levels mmHg	Classification	Male		Female	
		CMC (*n*=30) *n* (%)	NCMC (*n*=30) *n* (%)	CMC (*n*=30) *n* (%)	NCMC (*n*=30) *n* (%)
SBP (mm of Hg)					
<120	Normal	26 (52)	21 (42)	29 (58)	27 (54)
120–139	Pre hypertension	4 (8)	7 (14)	1 (2)	3 (6)
140–159	Stage I hypertension	-	2 (4)	-	-
≥160	Stage II hypertension	-	-	-	-
DBP (mm of Hg)					
<80	Normal	28 (56)	25 (50)	29 (58)	28 (56)
80–89	Pre hypertension	2 (4)	4 (8)	1 (2)	2 (4)
90–99	Stage I hypertension	-	1 (2)	-	-
≥100	Stage II hypertension	-	-	-	-

CMC: Camel milk consumers, NCMC: Non-camel milk consumers, SBP: Systolic blood pressure, DBP: Diastolic blood pressure

difference was found. The mean LDL levels of all participants were found to be within normal ranges, that is, 80–100 mg/dL (WHO).

HDL cholesterol

CMC (51.93 ± 8.20) had more mean (SD) HDL level (mg/dL) than NCMC (45.07 ± 6.37) male participants. The difference was statistically significant ($P < 0.001$). Similarly, among female participants, CMC (53.43 ± 4.68) had more mean (SD) HDL level (mg/dL) than NCMC (48.37 ± 4.68). The difference was statistically significant ($P < 0.001$).

Female participants had total cholesterol at a desired level. All the female CMC participants had the desired level of total cholesterol. None of them had high total cholesterol.

Majority of the male participants (CMC 96.7%, NCMC 90%) and NCMC (90%) female participants had LDL at an optimal level. All the female CMC participants had optimal levels of LDL. None of them had high or very high LDL. Majority of the male participants (CMC 96.7%, NCMC 93.4%) and female participants (CMC 96.7%, NCMC 90%) had HDL at an intermediate level [Table 6].

Table 4: Distribution of the participants with respect to their mean+SD blood pressure level.

Blood pressure mmHg	Male		*P*-value	Female		*P*-value
	CMC *n*=30	NCMC *n*=30		CMC *n*=30	NCMC *n*=30	
SBP Mean (SD)	119.22±11.33	122.46±15.19	0.35	118.84±5.81	122.36±7.67	0.049
DBP Mean (SD)	78.76±7.01	81.16±8.53	0.24	77.88±5.17	80.32±4.84	0.06

SD: Standard deviation, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, CMC: Camel milk consumers, NCMC: Non-camel milk consumers

Table 5: Mean±SD values of blood lipid profile fractions of the participants low-density lipoprotein (LDL-C).

Blood lipid profile fractions mean (SD)	Suggested values (mg/dL)	Male		*P*-value	Female		*P*-value
		CMC	NCMC		CMC	NCMC	
Total Cholesterol	<200	169.77±9.68	170.57±15.70	0 0.81	162.07±8.10	164.50±8.09	0.25
LDL	80–160	93.93±7.46	97.48±17.5	0.31	88.10±5.75	91.53±7.49	0.05
HDL	30–70	51.93±8.20	45.07±6.37	0.0006	53.43±4.68	48.37±4.68	0.0001

SD: Standard deviation, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, CMC: Camel milk consumers, NCMC: Non-camel milk consumers

Table 6: Distribution of the participants based on their blood lipid profile fraction.

Blood lipid profile fractions (mg/dL)	Classification	Male		Female	
		CMC (*n*=30) *n* (%)	NCMC (*n*=30) *n* (%)	CMC (*n*=30) *n* (%)	NCMC (*n*=30) *n* (%)
Total cholesterol					
<200	Desirable	29 (96.7)	27 (90)	30 (100)	28 (93.4)
200–239	Borderline high	1 (3.3)	3 (10)	-	2 (6.6)
≥240	High	-	-	-	-
LDL					
<100	Optimal	96.7 (29)	90 (27)	100 (30)	90 (27)
100–129	Near/above optimal	1 (3.3)	3 (10)	-	2 (6.6)
130–159	Borderline high	-	-	-	-
160–189	High	-	-	-	-
≥190	Very high	-	-	-	-
HDL					
<40	Low	1 (3.3)	2 (6.6)	1 (3.3)	3 (10)
40–59	Intermediate	29 (96.7)	28 (93.4)	29 (96.7)	27 (90)
≥60	High	-	-	-	-

CMC: Camel milk consumers, NCMC: Non-camel milk consumers, LDL: Low-density lipoprotein, HDL: High-density lipoprotein

DISCUSSION

Blood glucose level is an important determinant of the health status of a person. Besides being a predictor for diabetes, elevated blood glucose level predicts an increased risk of heart disease and mortality. It is well known for its systemic effects on a variety of problems associated with the disease, death being one of the most dreaded outcomes. These complications include macrovascular and microvascular complications. In addition, recent research has shown a connection between diabetes and uncommon consequences such as mental health, cancer, disability, and liver illness.[19]

In this study, only 3.3% CMC males were hyperglycemic, much lesser than the NCMC males (26.6%). None of the CMC females were hyperglycemic, while 23.3% NCMC females were hyperglycemic. These results were in tune with the study conducted by Agrawal *et al*. and Wang *et al*. and the systematic review conducted by Mirmiran *et al*.[20-22] while a study conducted by Ejtahed *et al*. found no change in blood glucose status between CMC and NCMC groups.[23] This variation in their glucose level may indicate impact of camel milk consumption by the CMC participants. The prevalence of diabetes in NCMC group was higher than the state and national average, indicating an urgent need for proper health intervention.

With around 90 million disability-adjusted life years (DALYs) for women and 125 million DALYs for men, HTN ranks as the second-leading risk factor for men and the top risk factor for women globally. After hemorrhagic stroke and ischemic stroke, ischemic heart disease is the leading cause of death due to high SBP.[24] The relationship between BP and risk of CVD events is continuous, consistent, and independent of other risk factors. Higher the BP, the greater is the chance of heart failure and stroke. Study participants were classified as per JNC 7 (2003) report.[17]

SBP and DBP were less in CMC than NCMC irrespective of gender. However, only a statistical difference was observed during the measurement of SBP of CMC and NCMC females. Classification of BP indicates that the majority of the participants were falling in the normal category in systolic and DBP. Few of them were either pre-hypertensive or were suffering from stage I HTN, but NCMC group had a greater prevalence of HTN than the CMC group. A similar finding was also reported by Agrawal *et al.,* in their study with a mean 118.4 SBP and a mean 75.0 mmHg DBP in adults of rural area of Rajasthan.[20] There was a scarcity of human studies. Various studies on rats provided information about anti-hypertensive properties of camel milk.[25,26]

TC and lipoproteins, that is, low density (LDL) and high density (HDL) are the major constituents of the lipid profile. Their biochemical investigation is of vital significance in the diagnosis of many disorders, especially CVDs.[27]

A raised concentration of plasma LDL and a low concentration of HDL fractions associated with high BP are the important risk factors of coronary heart diseases. With the gain in body weight, the situation worsens. It carries about two-thirds or more of the total plasma cholesterol in addition to other lipids. It is mainly synthesized in the liver and transports fat and cholesterol to the tissues. As LDL carries cholesterol to the cells for depositing in the tissues, it is considered the main agent of concern in elevated serum cholesterol levels. An excess of cholesterol gets deposited in the arteries; hence, LDL-C is commonly called bad cholesterol. Therefore, it was necessary to find out LDL level of the participants in the study.[27]

Guthrie has stated that the consumption of groundnut oil in daily diets increases MUFA intake and thereby balances the LDL level. The participants of the present study were also consuming groundnut oil as the chief source of fat in their diet. Moreover, their mean energy intakes were also almost matching the Recommended Dietary Allowance values.[28]

HDL-C carries less total lipid and more protein and, therefore has the highest density. It is also synthesized in the liver from endogenous fat sources. As HDL transports free cholesterol from the tissues to the liver for catabolism and excretion, higher levels of serum HDL are considered protective against CVDs and considered good cholesterol. CMC (53.43 ± 4.68) had more mean (SD) HDL level (mg/dL) than NCMC (48.37 ± 4.68) females. The difference was statistically significant ($P < 0.001$). In conformity with the present findings, Singh *et al.* also observed significant difference in HDL levels among adults (aging 25–65 years).[29]

In this study, we found that total cholesterol, LDL levels were less, and HDL level was more in CMC compared to NCMC irrespective of gender, suggesting the beneficial effects of camel milk on lipid profile. Similar results were found by various studies.[22,30] Contrasting results were presented by Ejtahed *et al*.[23]

Strengths

Single clinician collected and measured the blood sample. Thus, interpersonal bias was reduced. Regular calibration of the laboratory instruments reduced instrumental error. To minimize the confounding effect, one NCC with comparable age, gender, and place of residence was recruited for each CMC. It was a community-level study, hence will produce pragmatic results.

Limitations

The potential for recall bias and social desirability bias during interviews were significant problems. The present study was conducted on the Riaka tribe. Thus, it cannot be generalized to all the tribal population.

CONCLUSION

The prevalence of NCDs was relatively less in CMC than NCMC irrespective of gender, suggesting the beneficial effects of camel milk consumption. It is advised that additional research be conducted in the future.

Recommendation

We advocate performing more in-depth research, preferably clinical trials at the community level with a bigger adequate sample size to get better results and inferences.

Availability of data and materials

All the relevant data and materials are available.

Authors' contributions

Dr. Vaishali Soni – Planning, research formulation, data collection, compilation, and writing. Dr. Pritam Halder – Planning, analysis, compilation, and writing.

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Ethical approval

Approved by the Institutional Ethics Committee at Swami Keshwanand Rajasthan Agricultural University, Bikaner. number IEC SKRAU-70, dated 15 April 2013.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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