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Community-based millet intervention improves nutrient intake among adults in rural and tribal communities of Andhra Pradesh, India

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Abstract:

Millet has attracted renewed attention as nutrient-dense cereals with considerable potential to address non-communicable disease challenges. Therefore, it is of interest to assess the impact of a 12-week millet-based nutrition intervention on adults living in rural and tribal communities of Andhra Pradesh. A community-based cohort study was conducted among 345 adults aged 30 years and above from rural (n=180) and tribal (n=165) areas across three regions of Andhra Pradesh. Participants attended weekly "Mother's Kitchen" sessions over a period of 12 weeks and dietary intake was assessed. At baseline, only 26.4% of participants reported millet consumption during the dietary recall period and significant improvements were observed in nutrient intake following the intervention.

Keywords: Community-based intervention: dietary intake, millets

Background:

Population ageing is one of the most significant demographic transitions of the twenty-first century. Globally, the number of people aged 60 years and above is projected to reach 2.1 billion by 2050, with nearly 80% residing in low- and middle-income countries [1]. India is undergoing a similar transition, with its elderly population expected to increase from 138 million in 2021 to nearly 340 million by 2050 [2]. This demographic shift presents major challenges for health systems, social support mechanisms and nutritional security, particularly in rural and tribal communities where access to healthcare and nutritious foods remains limited [3, 4]. Older adults are vulnerable to poor nutritional status because of age-related physiological changes, chronic illnesses, reduced appetite, functional limitations and economic constraints, factors which contribute to protein-energy malnutrition, sarcopenia, osteoporosis, anaemia, frailty and impaired immunity [5]. At the same time, the burden of non-communicable diseases such as diabetes, hypertension and cardiovascular disease continues to increase among adults and elderly, creating a complex nutritional landscape that requires sustainable and culturally acceptable dietary solutions [6]. Millets have attracted renewed attention as nutrient-dense cereals with considerable potential to address these challenges. Compared with refined cereals such as rice and wheat, millets are richer in dietary fibre, protein, calcium, iron and several essential micronutrients [7, 8]. Finger millet is particularly notable for its exceptionally high calcium content, while other millet varieties provide significant quantities of iron and dietary fibre [9]. Evidence from intervention studies suggests that regular millet consumption can improve glycaemic control, iron status, micronutrient intake and overall dietary quality [10-12]. Declining millet consumption, urbanization, increased dependence on rice and wheat and the perception of millets as foods associated with lower socioeconomic status have contributed to reduce millet consumption [13-15]. Poor availability, affordability concerns, limited knowledge regarding

preparation methods and changing food habits continue to restrict millet use across communities [16]. Community-based nutrition interventions that combine practical demonstrations with culturally acceptable dietary education may offer a more effective strategy for promoting sustainable dietary behaviour change [17]. Although millet-based interventions have been evaluated among children, adolescents and women, evidence focusing specifically on elderly populations remains limited, particularly in rural and tribal settings [18]. Therefore, it is of interest to evaluate the impact of a community-based millet intervention on nutrient intake among adults and elderly residing in rural and tribal Andhra Pradesh.

Methods:**Study design and setting:**

A community-based cohort study was conducted between March 2024 and September 2025 across three geographically distinct regions of Andhra Pradesh, India. The study was undertaken in Guntur district, Visakhapatnam and Anakapalle district and Annamayya district, representing different agro-ecological and cultural regions of the state. Both rural and tribal communities were included to capture regional diversity in dietary practices and millet consumption.

Study population:

Adults aged 30 years and above who had been residing in the study area for at least six months and were willing to provide written informed consent were eligible to participate. Individuals with acute illness at the time of recruitment or those unwilling to participate in the intervention activities were excluded. Although the primary focus of the study was healthy ageing, adults aged 30 years and above were included to capture dietary behaviours across the ageing continuum and to understand factors influencing millet consumption before the onset of older age.

Sample size and sampling procedure:

The sample size was estimated using the cluster sampling formula with a confidence level of 95%, precision of 15%, a design effect of two and ten clusters. The minimum required sample size was 345 participants. A multistage sampling strategy was adopted. Five mandals were randomly selected from each study district (3 districts) using the lottery method. Within each selected mandal (cluster), one rural and one tribal Anganwadi cluster were randomly chosen. Eligible households were enumerated and 23 participants were recruited from each cluster, yielding a final sample of 345 participants.

Intervention:

The intervention consisted of a 12-week community-based nutrition programme known as the “Mother’s Kitchen” millet recipe sessions. Weekly sessions were conducted by trained nutritionists at Anganwadi centres or community venues in groups of five to ten participants. Participants were introduced to nine true millet varieties, namely finger millet, pearl millet, foxtail millet, little millet, kodo millet, proso millet, barnyard millet, brown top millet and sorghum, together with two pseudo-cereals, amaranth and buckwheat. A total of 82 culturally appropriate millet-based recipes were demonstrated during the intervention period. The recipes were designed to be affordable, easy to prepare, nutritionally rich and acceptable to local food habits. Sessions included live cooking demonstrations, tasting opportunities, practical guidance on preparation techniques and interactive discussions addressing barriers to millet consumption. Adequate exposure to the intervention was defined as attendance at seven or more of the twelve sessions.

Data collection:

Data collection was carried out by trained investigators following a two-week training programme on study procedures, interviewing techniques and dietary assessment methods. All study instruments were pilot tested before implementation and regular supervisory visits were conducted throughout the study period.

Socio-demographic assessment:

A structured pre-tested questionnaire was used to collect information on age, educational status, occupation, marital status, household characteristics and self-reported morbidity. Household socioeconomic status was assessed using a standard-of-living index.

Dietary assessment:

Dietary intake was assessed at baseline and end line using three non-consecutive 24-hour dietary recalls. Participants were asked to report all foods and beverages consumed during the preceding 24 hours. Portion sizes were estimated using standardized household utensils, food photographs and visual aids incorporated within DietCalc software. Daily nutrient intake was calculated using DietCalc software based on the Indian Food Composition Tables (IFCT 2017). Particular emphasis was placed on estimating energy, protein, calcium and

iron intake, as well as food group consumption patterns. The use of repeated dietary recalls helped to capture day-to-day variation and provided a more reliable estimate of usual dietary intake.

Anthropometric assessment:

Body weight and height were measured using calibrated SECA instruments. Weight was recorded to the nearest 0.1 kg and height to the nearest 0.1 cm. Duplicate measurements were obtained and averaged for analysis.

Qualitative assessment:

Qualitative information was collected through group discussions conducted during intervention sessions. Discussions explored perceptions regarding millet consumption, barriers, facilitators and participant experiences with the intervention. Audio recordings were transcribed verbatim and translated into English where necessary. Data were analysed using thematic analysis with ATLAS.ti version 8.

Outcome measures:

Primary outcomes included, proportion of participants consuming millets, Mean daily millet intake (g/day) and Changes in dietary intake of protein, energy, calcium and iron between baseline and endline. Secondary outcomes included, Perceived barriers and facilitators of millet consumption, Changes in food group consumption patterns, Regional variation in millet consumption and Socio-demographic predictors of millet consumption.

Statistical analysis:

Data was entered into Microsoft Excel and analysed using SPSS Version 25. Continuous variables were summarised using means and standard deviations or medians with interquartile ranges, as appropriate. Categorical variables were presented as frequencies and percentages. Associations between categorical variables were assessed using the Chi-square test or Fisher’s exact test. Continuous variables were compared using the independent t-test or Mann-Whitney U test. Changes between baseline and endline measurements were assessed using paired t-tests or Wilcoxon signed-rank tests, depending on data distribution. Multivariable logistic regression analysis was performed to identify independent predictors of millet consumption. Variables with $p < 0.20$ in bivariate analysis were entered into the multivariable model. Adjusted odds ratios (aOR) with 95% confidence intervals were reported. Statistical significance was set at $p < 0.05$.

Ethical considerations:

The study was approved by the Institutional Ethics Committee of the All India Institute of Medical Sciences, Mangalagiri (IEC No. AIIMS/MG/IEC/2024-25/145; dated 29 November 2024). Written informed consent was obtained from all participants before enrolment. Participant confidentiality was maintained

through anonymised data handling and secure storage of study records.

Results:

A total of 345 participants were enrolled in the study, comprising 180 individuals from rural communities and 165 from tribal communities. Two participants were lost to follow-up during the intervention period, resulting in a final analytical sample of 343 participants for endline assessment. The mean age of participants was 57.4 ± 12.6 years and approximately three-fourths (75.9%) belonged to the 51–70-year age group. Educational attainment was low, with more than four-fifths of participants reporting no formal education. Illiteracy was significantly higher among tribal participants than rural participants (94.5% vs. 76.7%, $p<0.001$). Daily wage labour was the predominant occupation, followed by homemaking activities. Nearly one-third of participants were widowed. Most participants (67.2%) reported no known chronic illness, while hypertension and diabetes were reported by 14.5% and 7.5%, respectively (Table 1). Awareness regarding millets was universal among study participants. The most frequently reported reason for millet consumption was their perceived nutritional value (70.1%), followed by cultural or traditional practices (21.2%) and health-related reasons (14.8%). Cultural motivations were reported significantly more often among rural participants than tribal participants (25.6% vs. 16.4%, $p=0.039$). Despite widespread awareness, several barriers to regular millet consumption were identified. Lack of availability emerged as the most commonly reported barrier (58.6%), followed by unfamiliarity with millet varieties other than finger millet (48.7%) and affordability concerns (26.1%). Cost-related barriers were significantly more common among tribal participants than rural participants (31.5% vs. 21.1%, $p=0.030$). Taste was infrequently cited as a barrier, indicating that access-related factors may play a greater role than food acceptability in determining millet consumption (Table 2). At baseline, only 26.4% of participants reported consuming millets during the 24-hour dietary recall period. Among consumers, the mean daily millet intake was 67.23 ± 46.33g. Marked regional variation in millet consumption was observed. Consumption was highest in Rayalaseema, where more than two-thirds of tribal participants and over 60% of rural participants reported millet intake. In contrast, millet consumption remained low in Uttar Andhra and Coastal Andhra. Self-reported consumption frequency also differed significantly between rural and tribal populations ($p=0.004$), with tribal participants more likely to report infrequent consumption. Finger millet (ragi) was the most

commonly consumed millet variety, followed by sorghum (jowar) and pearl millet (bajra) (Table 3). Comparison of baseline and endline assessments among the 343 participants who completed follow-up demonstrated significant improvements in key nutritional indicators following the 12-week intervention. Mean protein intake increased from 43.72 ± 32.36 g/day at baseline to 49.60 ± 18.75 g/day at endline ($p=0.002$). Mean daily energy intake increased from 1591.40 ± 1294.10 kcal to 1743.37 ± 667.06 kcal ($p=0.031$). Significant improvements were also observed in calcium intake, which increased by 22.8% from 314.82 ± 211.80 mg/day to 386.47 ± 343.43 mg/day ($p<0.001$) and iron intake, which increased by 20.5% from 7.69 ± 5.00 mg/day to 9.27 ± 5.15 mg/day ($p<0.001$) (Table 4). In addition to improvements in nutrient intake, significant changes were observed in dietary patterns following the intervention. Consumption of cereals and millets increased substantially, accompanied by higher intake of milk products and protein-rich foods. Fruit intake showed a small non-significant increase, whereas vegetable consumption decreased during the study period (Table 5). Multivariable logistic regression analysis identified geographical region as the strongest determinant of millet consumption. Compared with participants residing in Coastal Andhra, those from Rayalaseema were significantly more likely to consume millets (aOR 4.86; 95% CI: 2.34-10.12; $p<0.001$), whereas participants from Uttar Andhra were significantly less likely to consume millets (aOR 0.32; 95% CI: 0.14-0.73; $p=0.007$). No statistically significant associations were observed for place of residence, educational status, age group, hypertension, or diabetes mellitus after adjustment for potential confounders (Table 6). Thematic analysis of focus group discussions identified five major themes influencing millet consumption: acceptability, accessibility, affordability, appropriateness and utilization. Participants generally perceived millets as nutritious and beneficial for health. However, limited market availability, rising costs, inadequate knowledge regarding preparation methods, storage concerns and the time required for preparation emerged as important barriers to regular consumption. Many participants described a gradual decline in millet consumption across generations despite recognising their nutritional value. Participants also reported that the recipe demonstration sessions improved their knowledge, confidence and willingness to prepare millet-based foods using locally available ingredients. The interactive nature of the intervention was widely appreciated and was perceived as helpful in translating awareness into practical dietary practices.

Table 1: Socio-demographic and health characteristics of study participants (N = 345)

Characteristic	Rural (n=180)	Tribal (n=165)	Total (n=345)	p-value
Age group (years)				0.826
30-50	38 (21.1)	31 (18.8)	69 (20.0)	
51-70	135 (75.0)	127 (77.0)	262 (75.9)	
>70	7 (3.9)	7 (4.2)	14 (4.1)	
Education				<0.001
No formal education	138 (76.7)	156 (94.5)	294 (85.2)	
Primary	11 (6.1)	3 (1.8)	14 (4.1)	
Middle school	4 (2.2)	1 (0.6)	5 (1.4)	

High school and above	27 (15.0)	5 (3.0)	32 (9.3)	0.003
Occupation				
Farmer	15 (8.3)	14 (8.5)	29 (8.4)	
Daily wage labour	75 (41.7)	67 (40.6)	142 (41.2)	
Homemaker	53 (29.4)	56 (33.9)	109 (31.6)	
Retired	14 (7.8)	5 (3.0)	19 (5.5)	0.585
Other	23 (12.8)	23 (13.9)	46 (13.3)	
Marital status				
Married	125 (69.4)	119 (72.1)	244 (70.7)	
Widowed	55 (30.6)	46 (27.9)	101 (29.3)	
Consanguineous marriage				0.068
Yes	45 (25.0)	28 (16.9)	73 (21.2)	
No	135 (75.0)	137 (83.1)	272 (78.8)	
Morbidity profile				0.499
No reported morbidity	122 (67.8)	110 (66.7)	232 (67.2)	
Hypertension	26 (14.4)	24 (14.5)	50 (14.5)	
Diabetes mellitus	18 (10.0)	8 (4.8)	26 (7.5)	
Hypertension and diabetes	6 (3.3)	3 (1.8)	9 (2.6)	
Other conditions	14 (7.8)	23 (13.9)	37 (10.7)	

Table 2: Awareness, perceived benefits and barriers related to millet consumption among study participants (N = 345)

Variable	Rural n (%)	Tribal n (%)	Total n (%)	p-value
Perceived benefits*				
Nutritional benefits	124 (68.9)	118 (71.5)	242 (70.1)	0.551
Cultural/traditional reasons	46 (25.6)	27 (16.4)	73 (21.2)	0.039
Health conditions	24 (13.3)	27 (16.4)	51 (14.8)	0.429
Dietary restrictions	26 (14.4)	23 (13.9)	49 (14.2)	0.894
Taste preference	1 (0.6)	4 (2.4)	5 (1.4)	0.185
Barriers to consumption*				
Lack of availability	109 (60.6)	93 (56.4)	202 (58.6)	0.428
Unfamiliarity with millet varieties	87 (48.3)	81 (49.1)	168 (48.7)	0.888
Cost concerns	38 (21.1)	52 (31.5)	90 (26.1)	0.03
Preference for other grains	34 (18.9)	18 (10.9)	52 (15.1)	0.057
Taste concerns	1 (0.6)	1 (0.6)	2 (0.6)	1

*Multiple responses permitted.

Table 3: Baseline millet consumption patterns among study participants (N = 345)

Variable	Rural (n=180)	Tribal (n=165)	Total (n=345)	p-value
24-hour recall millet consumption				0.11
Consumed millet	41 (22.8)	50 (30.3)	91 (26.4)	0.004
Did not consume millet	139 (77.2)	115 (69.7)	254 (73.6)	
Frequency of millet consumption				
Daily	27 (15.0)	7 (4.2)	34 (9.9)	
Weekly	65 (36.1)	55 (33.3)	120 (34.8)	
Monthly	14 (7.8)	17 (10.3)	31 (9.0)	0.702
Rarely	66 (36.7)	82 (49.7)	148 (42.9)	
Never	8 (4.4)	4 (2.4)	12 (3.5)	
Mean millet intake among consumers (g/day)	65.16 ± 46.51	68.93 ± 46.58	67.23 ± 46.33	

Table 4: Changes in nutrient intake following the 12-week millet intervention among participants completing follow-up (n = 343)

Nutrient	Baseline Mean ± SD	Endline Mean ± SD	Mean Change	p-value
Protein (g/day)	43.72 ± 32.36	49.60 ± 18.75	5.88	0.002
Energy (kcal/day)	1591.40 ± 1294.10	1743.37 ± 667.06	151.97	0.031
Calcium (mg/day)	314.82 ± 211.80	386.47 ± 343.43	71.65	<0.001
Iron (mg/day)	7.69 ± 5.00	9.27 ± 5.15	1.58	<0.001

Table 5: Changes in food group intake following the intervention (n = 343)

Food Group	Baseline Median (IQR)	Endline Median (IQR)	p-value
Cereals and millets (g)	206.80 (182.00)	275.42 (220.11)	0.001
Vegetables (g)	81.91 (82.58)	64.00 (62.75)	0.001
Fruits (g)	3.02 (8.17)	4.00 (10.66)	0.476
Milk and milk products (g)	83.00 (63.33)	108.67 (141.91)	<0.001
Protein-rich foods (g)	39.93 (36.31)	55.00 (69.30)	<0.001
Millet intake only (g)	66.67 (66.67)	66.67 (60.00)	0.426

Table 6: Multivariable logistic regression analysis of factors associated with millet consumption (n = 343)

Variable	Adjusted Odds Ratio (aOR)	95% Confidence Interval	p-value
Region (Reference: Coastal Andhra)			
Rayalaseema	4.86	2.34 - 10.12	<0.001
Uttar Andhra	0.32	0.14 - 0.73	0.007

Residence (Reference: Tribal)			
Rural	0.68	0.42 - 1.10	0.115
Education (Reference: No formal education)			
Literate	1.42	0.85 - 2.37	0.183
Age group (Reference: 51-70 years)			
30-50 years	1.18	0.69 - 2.02	0.548
>70 years	0.61	0.18 - 2.06	0.426
Hypertension	1.38	0.74 - 2.57	0.31
Diabetes mellitus	1.82	0.78 - 4.25	0.166

Model fit: Hosmer-Lemeshow goodness-of-fit test $p = 0.342$.

Discussion:

The present study evaluated millet consumption patterns and the impact of a 12-week community-based millet intervention among adults and elderly individuals residing in rural and tribal areas of Andhra Pradesh. Three key findings emerged from the study. First, despite universal awareness regarding millets, actual consumption remained low, indicating a substantial awareness-practice gap. Second, the community-based intervention was associated with significant improvements in protein, energy, and calcium and iron intake. Third, strong regional variation in millet consumption was observed, with Rayalaseema residents demonstrating substantially higher odds of millet consumption than participants from other regions. Although all participants had heard about millets and were aware of their perceived health benefits, only about one-fourth reported consuming millets during the dietary recall period. Similar observations have been reported from other parts of India. Dave and Patel found high awareness but relatively low regular millet consumption among Indian households, suggesting that awareness alone does not necessarily translate into sustained dietary behaviour change [19]. Studies from Odisha and Andhra Pradesh have similarly documented that consumers often acknowledge the nutritional benefits of millets but continue to rely predominantly on rice and wheat because of convenience, availability and familiarity [13]. These findings suggest that improving awareness alone is unlikely to substantially increase millet consumption unless structural barriers are simultaneously addressed. The barriers identified in the present study were primarily related to accessibility rather than acceptability. Lack of availability, unfamiliarity with millet varieties other than finger millet and affordability concerns were the most frequently reported obstacles. Similar barriers have been documented across India, where changing food environments, declining millet cultivation and increased dependence on rice and wheat have contributed to reduced millet consumption [20-22]. Importantly, taste was rarely identified as a barrier, indicating that consumer acceptance may not be the principal challenge. Instead, access, affordability and practical knowledge regarding preparation appear to be more important determinants of consumption. One of the most important findings of the study was the significant improvement in nutrient intake following the intervention. Protein intake increased by 13.4%, energy intake by 9.5%, calcium intake by 22.8% and iron intake by 20.5%. These improvements are particularly relevant in the context of healthy ageing. Older adults frequently experience inadequate intake of protein and essential micronutrients because of physiological, social and

economic factors, increasing their susceptibility to sarcopenia, frailty, osteoporosis, anaemia and functional decline [5-8]. The observed improvements suggest that community-based millet promotion can contribute meaningfully to addressing nutritional vulnerabilities among ageing populations. The increase in calcium intake is of particular significance. Finger millet, the most commonly consumed millet in the study population, is one of the richest cereal sources of calcium and has been widely recognised for its potential role in supporting bone health [11, 12]. Systematic reviews have showed favourable effects of finger millet on calcium retention and bioavailability [23]. Similarly, the observed improvement in iron intake has important public health implications. Iron deficiency and anaemia remain common among older adults and are associated with reduced physical capacity, impaired cognition and diminished quality of life. A recent systematic review and meta-analysis showed that millet consumption significantly improves haemoglobin levels and iron status [13]. Studies involving biofortified pearl millet have also reported enhanced iron absorption and improved iron stores among vulnerable populations [24]. The findings of the present study further support the role of millet-based dietary approaches in improving micronutrient intake. The intervention also appeared to influence dietary quality beyond millet consumption alone. Increased consumption of cereal-based foods, milk products and protein-rich foods was observed following the intervention, suggesting that practical nutrition education may encourage broader improvements in dietary behaviour. Participatory food-based interventions have previously demonstrated similar effects by improving confidence, food preparation skills and dietary diversity [17, 18]. However, the decline in vegetable intake observed during the study period warrants further investigation and may reflect seasonal variation, substitution effects, or contextual influences that were not fully captured. A notable finding was the marked regional variation in millet consumption. Participants residing in Rayalaseema were nearly five times more likely to consume millets than those from Coastal Andhra, even after adjustment for potential confounding factors. These differences likely reflect variations in agricultural practices, food cultures, historical dietary traditions and local food environments. Rayalaseema has long been recognised as a millet-growing region with strong cultural acceptance of millet-based foods, whereas rice remains the dominant staple in coastal regions. Similar regional disparities have been reported in national studies examining millet consumption patterns across India [14, 19]. These findings highlight the need for region-specific approaches rather than uniform nutrition interventions. The qualitative findings

complemented the quantitative results and provided important insights into community perceptions. Participants generally viewed millets as nutritious and beneficial for health, but practical challenges such as poor market availability, increasing prices, limited knowledge regarding preparation methods, storage concerns and time constraints restricted their routine use. Encouragingly, participants reported that the cooking demonstrations improved their confidence and willingness to prepare millet-based foods at home. These findings support previous evidence indicating that participatory and community-based nutrition education approaches can facilitate meaningful dietary behaviour change [17, 18]. The study has several strengths. It included a relatively large sample drawn from both rural and tribal populations across geographically diverse regions of Andhra Pradesh. The use of repeated dietary assessments, high participant retention and a mixed-methods approach strengthened the validity of the findings. Furthermore, the intervention was implemented under real-world community conditions, enhancing the practical relevance and potential scalability of the results. However, several limitations should be acknowledged. The absence of a control group limits causal inference regarding intervention effectiveness. Dietary intake was assessed using self-reported 24-hour recalls and may therefore be subject to recall bias. Nutritional improvements were evaluated using dietary estimates rather than biochemical indicators, preventing direct assessment of changes in nutritional status. Seasonal variations in food availability were not fully captured. Finally, although the study focused on healthy ageing, inclusion of participants aged 30 years and above may limit direct comparability with studies restricted to older age groups. Overall, the findings suggest that community-based millet promotion programmes represent a feasible, culturally acceptable and potentially effective strategy for improving dietary quality among ageing populations in rural and tribal settings. However, sustained improvements in millet consumption will require complementary efforts to improve availability, affordability and accessibility through agricultural policies, market strengthening and integration within existing food and nutrition programmes. Such multi-sectoral approaches may help harness the nutritional potential of millets to support healthy ageing and nutritional security in India.

Conclusion:

A community-based millet promotion programme significantly improved dietary intake of protein, energy, calcium and iron among adults and elderly participants in rural and tribal Andhra Pradesh. Strengthening millet availability and integrating community-based nutrition education into existing programmes may enhance dietary quality and support healthy ageing.

Strengths and limitations:

This study provides community-based evidence on millet consumption and intervention effectiveness among rural and tribal populations, with high participant retention and comprehensive dietary assessment. However, the absence of a control group, reliance on self-reported dietary data and lack of

biochemical outcome measures limit causal interpretation and assessment of clinical impact.

Conflicts of Interest of each author/ contributor: None

Criteria for inclusion in the authors'/ contributors' list:

Concept and design: Arti Gupta, Venkatesh Reddy B, Rajeev Aravindakshan. Acquisition, analysis, or interpretation of data: Arti Gupta, Joe Amalan, Mohammed Adil Hussain, Pulla SIRISHA, Venkatesh Reddy B, Rajeev Aravindakshan, Dr. Vijay Kishore, Dr. Praveen Kumar S. Drafting of the manuscript: Arti Gupta, Joe Amalan, Mohammed Adil Hussain, Pulla SIRISHA, Venkatesh Reddy B, Rajeev Aravindakshan. Critical review of the manuscript for important intellectual content: Arti Gupta, Mohammed Adil Hussain, Joe Amalan, Pulla SIRISHA, Venkatesh Reddy B, Rajeev Aravindakshan, Dr. Vijay Kishore, Dr. Praveen Kumar S. Final approval and Agreement to be accountable: Arti Gupta, Venkatesh Reddy B, Rajeev Aravindakshan,

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The manuscript has been read and approved by all the authors that the requirements for authorship as stated earlier in this document have been met and each author believes the manuscript represents honest work.

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