ORIGINAL ARTICLE

Determinants of Poison-related Mortality in Tertiary Care Hospital, South India

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Abstract

Aims and background: Acute poisoning is one of the most common emergencies in India and around the world. Understanding the factors associated with mortality can aid us in devising appropriate preventive strategies to curtail deaths due to poisoning. Purpose of this study is to find various factors that determine the mortality among acute poisoning cases admitted in a tertiary care center.

Materials and methods: A retrospective hospital records-based study was conducted at Chengalpattu Medical College Hospital. The study included 2,123 cases of various poisoning cases admitted for a year from January to December 2022. Cases of bites, stings, drowning, and hanging were excluded. Information on sociodemographic profile, type of poison, time since ingestion and admission, and treatment outcome were collected using a structured pro forma.

Results: The mean age of the study population was 29.90 ± 14.98 years. Poisoning was found to be predominantly among males (56.42%) and residents of rural areas (58%). Insecticide consumption (27.0%) was the most common modality, followed by oleander poisoning (20%), corrosive poison (17%), rat poison (15%), tablet poison (13%), and other poisons. The overall case fatality rate (CFR) was 5.2%, with the highest CFR of 12.25% with insecticide poisoning. In multivariate analysis, Glasgow coma scale (GCS) score at admission is the only parameter showing a statistically significant association with mortality (adjusted odds-ratio 0.271(0.2–0.38, p-value < 0.01).

Conclusion: Acute poisoning primarily affects the young and economically productive population. In the south Indian population, pesticides are still the major contributor though corrosives are a major contributor among children. Mortality is still significant, and GCS status admission is the only predictor of mortality.

Keywords: Acute poisoning, Corrosives, Insecticides, Mortality.

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Highlights

Acute poisoning young and economically productive population with male predominance. Insecticide poisoning is the major overall contributor with oleander, corrosive, and rat poisoning being other major contributors. The case fatality rate is 5.2%. The level of sensorium at admission as assessed by Glasgow coma score (GCS) is the only predictor of mortality.

Introduction

Acute poisoning, either unintentional or self-poisoning, is one of the major public health problems, especially affecting the young and economically productive population. Data are scarce on the overall burden of poisoning at the global level due to a lack of uniformity in reporting. A recent systematic review of data from 141 nations has estimated that about 385 million cases of acute pesticide poisoning are contributing to 11,000 fatalities globally, with South Asia being the highest contributor.[1] Global burden of self-poisoning, as per another review based on data from 108 countries, was about 0.17 million deaths annually.[2]

In India, there is no nationwide primary data on the burden of acute poisoning. As per the National Crime Records Bureau (NCRB) estimates, out of 1,64,033 suicides reported in 2021, 25.1% were attributed to poisoning, and another 0.4% were attributed to the consumption of sleeping pills.[3] Nationwide estimates based on published literature have reported about 230,000 suicides in India each year, of which about 30% are attributed to the use of pesticides.[4] But these numbers are likely to be a gross underestimate of the true burden of this major public health concern.

Due to industrialization and agricultural advancements, many insecticides are now widely accessible.[5] Due to the rising usage of

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agrochemicals in the agricultural sector, middle- and low-income nations experience a significant amount of pesticide exposure.[6] This is also resulting in constant change in the toxico-epidemiological profile of poisoning. Though pesticide consumption continues to be the predominant contributor, there is huge diversity in type of chemicals contributing to acute poisoning.[7] Clinical presentation and outcomes of some of these new agents is very poorly understood.[8] The young population, especially men in their 2nd and 3rd decade, continues to be the major contributors.[9,10]

Acute poisoning is one of the conditions with very high mortality and morbidity rates. Studies have reported a case fatality rate (CFR) of as high as 40%.[11] There is a dearth of quality scientific evidence regarding factors contributing to mortality among poisoning cases. The available evidence is predominantly from small-scale hospital-based studies with very limited sample sizes. Even the demographic, clinical, and toxicological parameters considered for analysis are quite inconsistent across the studies.[5,12,13]

Due to the constantly changing toxic epidemiological profile, there is a strong need for periodic real-world evidence studies on acute poisoning. Also, there is a need to understand the demographic, clinical, and toxicological aspects contributing to mortality among poisoning cases. This will enable the policymakers and health care providers at different levels to formulate appropriate preventive and care strategies to minimize the occurrence and adverse impact of acute poisoning. Hence, the current study is an attempt to present real-world evidence regarding the profile, mortality, and factors associated with mortality from tertiary care teaching hospitals in South India.

Materials and Methods

This retrospective, hospital record-based study was carried out among all the poisoning cases admitted between January 2022 and December 2022 in a tertiary care hospital in the suburban area of a district in Tamil Nadu. Out of 73,178 patients, we have included 2,123 poisoning cases admitted in general medicine ward, during the 1-year study period by purposive sampling. Some cases are referral from primary and secondary level health center from the rural areas. Patients with poisoning managed both in wards and ICU were included. Cases of bites, stings, hanging, or drowning were excluded. Total bed occupancy rate is 98% with 680 beds in the department of general medicine including 180 beds in ICU. Among the study participants, 272 patients required ICU admission, of which 125 patients required oxygen support, 4 ARDS, 124 patients had GCS score less than 8, 124 patients were mechanically ventilated, 3 patients required pacemaker, 5 patients with MODS (multiple organ dysfunction syndrome), 4 patients with hepatic insult, and 7 with AKI (acute kidney injury).

We have obtained approval from the Institutional Ethical Committee (IEC) for the study, along with a waiver of consent, considering the retrospective nature of the study. A structured data collection instrument was prepared to extract the data from the retrospective hospital records after obtaining permission. These records are maintained as case sheets in MRD. Information was collected on the demographic profile of the patients, the type of poison ingested, the time between poison intake and admission, and their treatment outcome. Severity of illness measured using qSOFA score.

Numeric variables were summarized by mean and standard deviation, and categorical variables were summarized by frequency and proportion. Numeric variables were compared between cases with and without mortality using an independent sample *t*-test, and categorical variables were compared using a Chi-square test. Univariate and multivariate logistic regression analysis was performed to analyze the factors independently associated with mortality. p-value < 0.05 was considered statistically significant. The Statistical Package for Social Sciences (SPSS version 24.0, IBM Corporation, USA) for MS Windows was used to statistically analyze all of the data.

Results

Out of 73,178, a total of 2,123 patients with poisoning cases were included in the study. The total number of the affected cases was 8.1% in the age-group of 0–14 years, 33.82% in the 15–24 years age-group, followed by 41.36% of cases in the 25–44 years age-group. The overall contribution of males (56.43%) was compared with that of females (43.57%). About 58% of poisoning cases in the study population were from rural areas. The majority of poisoning cases presented gastrointestinal symptoms like vomiting (51%), abdominal pain (14%), and diarrhea (8%) after consumption. Less than 1% of cases presented with bleeding manifestation and seizures. Only 21.34% of the cases reached the hospital within 1 hour, and another 38.53% reached between 1 and 3 hours. Among the remaining, 38.39% reached the hospital between 3 and 12 hours, and a minor proportion (1.74%) of them reached the hospital beyond 12 hours of consumption. The mean GCS score was 14.39 ± 1.89 (range 3–15) in the study population. The mean duration of hospital stay was 2.33 days (range 1–33), and 5.2% were reported in mortality (Table 1).

Insecticides were found to be the most common poisoning (33.44%), followed by oleander (20.3%), corrosive poison (16.3%), rat killer (14.51%), and consumption of the tablets (metformin, amlodipine, glimepiride antiepileptic drugs: sodium valproate, phenytoin, and diazepam) (13.24%), respectively (Fig. 1).

Among the children below 15 years, corrosive poisoning was the most common poison contributing to 62.8% of the cases. Among all other age-groups, insecticide poisoning was the most common type contributing to 26.3% and 34.5% in the 15–24 and 25–44 age-groups. Among older adults and elderly, more than 50% of the cases were attributed to insecticide poisoning. Gender disaggregated analysis also shows that the relative proportion of insecticide poisoning is higher among men as compared with women (38.7 vs 26.6%). Among women, tablet consumption was the second most common modality of poisoning, with 21.6% of cases (Fig. 2).

The univariate logistic regression analysis showed age-group, gender, type of poison, GCS, and time between intake and admission were found to be significant predictors of mortality ($p < 0.05$). Majority of deaths were seen in male population (unadjusted OR: 2.903; 95% CI: 1.83–4.60) when compared with female population. Mortality rate was higher in patients who consumed insecticide poisoning (unadjusted OR: 24.369; 95% CI: 5.97–99.6) followed by rat killer (unadjusted OR: 5.253; 95% CI: 1.13–24.50) when compared with unknown poisoning, corrosive poisoning, tablet poisoning, and oleander.

In multivariate analysis, the GCS score was found to be a significant predictor of mortality ($p < 0.05$). For every one unit increase in GCS score, there was 66.1% (unadjusted OR: 0.339; 95% CI: 0.29–0.4) lesser probability of mortality. Maximum patients expired when there was a delay in admission to hospital by more

Table 1: Summary of baseline parameters

Parameter	*Summary*
Age	29.9 ± 14.99 (range 1–96)
Age-group	
0–14	172 (8.1%)
15–24	718 (33.82%)
25–44	878 (41.36%)
45–60	267 (12.58%)
>60	88 (4.15%)
Gender	
Male	1,198 (56.43%)
Female	925 (43.57%)
Place of intake	
Rural	1,236 (58.22%)
Urban	887 (41.78%)
Type of poison	
Insecticide	710 (33.44%)
Oleander	431 (20.3%)
Rat killer	308 (14.51%)
Tablet poisoning	281 (13.24%)
Corrosive poison	351 (16.53%)
Unknown poisoning	42 (1.98%)
Time B/T intake and admission	3.75 ± 3.84 (range 1–96)
≤ 1 hour	453 (21.34%)
1.01–3 hours	818 (38.53%)
3.01–12 hours	815 (38.39%)
>12 hours	37 (1.74%)
Presenting complaints	
Vomiting	1,091 (51.39%)
Abdominal pain	302 (14.23%)
Diarrhea	164 (7.72%)
Breathlessness	105 (4.95%)
Altered sensorium	69 (3.25%)
Chest pain	37 (1.74%)
Seizures	25 (1.18%)
Bleeding manifestation	8 (0.38%)
Discoloration of urine	5 (0.24%)
Blood vomiting	2 (0.09%)
Fasciculations	54 (2.54%)
GCS (*N* = 2123)	14.39 ± 1.89 (range 3–15)
Duration of hospital stay (in days)	2.33 ± 2.26 (range 1–33)
Treatment outcome	
Discharged	2,013 (94.8%)
Expired	110 (5.2%)

than 12 hours after ingestion (unadjusted OR: 4.871; 95% CI: 1.47–16.14) (Table 2).

Mortality was highest among the older age-group (>60 years) (20.54%) with higher rates among males as compared with females (7.18 vs 2.59%). Predominant rate of mortality found among insecticide poisoning (12.25%), followed by unknown poisoning (11.9%). Case fatality had shown an increasing trend with increasing time between consumption and treatment, with 2.43% mortality among people reaching hospital min to <1 hour to about 10.81% of the people dying when the time to treatment was more than 24 hours. There was statistically significant difference between treatment outcomes with demographic parameters, such as age, gender, type of poison and time B/T intake and admission (p-value < 0.001) (Table 3).

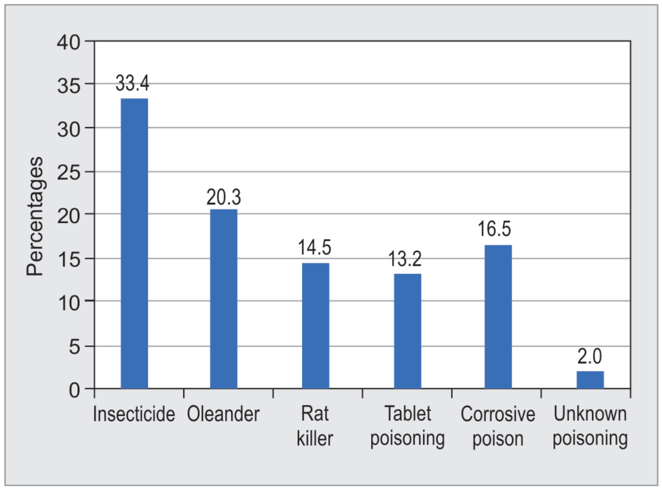

Fig. 1: Bar chart of type of poison in the study population (*N* = 2,123)

Discussion

Acute poisoning remains a public health challenge due to a multitude of factors. The range of substances that can result in acute poisoning, either intentionally or unintentionally, has witnessed rapid expansion in the last two decades. This poses a challenge to policymakers, implementation agencies, and healthcare providers, as they need to keep pace with these rapid changes. Periodic studies on the subject, like the current study, are vital in understanding these changing trends.

As per the current study, the highest proportion of the affected population is in their 2nd–4th decade of life, which is economically and socially the most productive population. This has been a constant finding across many studies published from India and other lower and middle-income countries (LMICs) and has not witnessed major changes.[9,14,15] This highlights the need to have suitable institutional mechanisms in place to engage with this population group to address the underlying factors to prevent intentional consumption of poison. A disproportionately high proportion of males affected is also one of the consistent findings across the studies. In some studies, the proportion of males was marginally higher,[16] but the majority of the studies have reported the proportion of males to be between 60 and 70%.[17–21] It is crucial to consider the social and cultural factors that may impact gender differences. Factors that might contribute to this phenomenon are pressure of social obligations from the family and society, lack of adequate skills to handle transition periods of life, complex situations in professional and personal life, economic distress, etc.[16] It is also likely that men may be more likely to work in occupations that involve hazardous materials or chemicals. Further research is needed to fully understand the complex relationship between

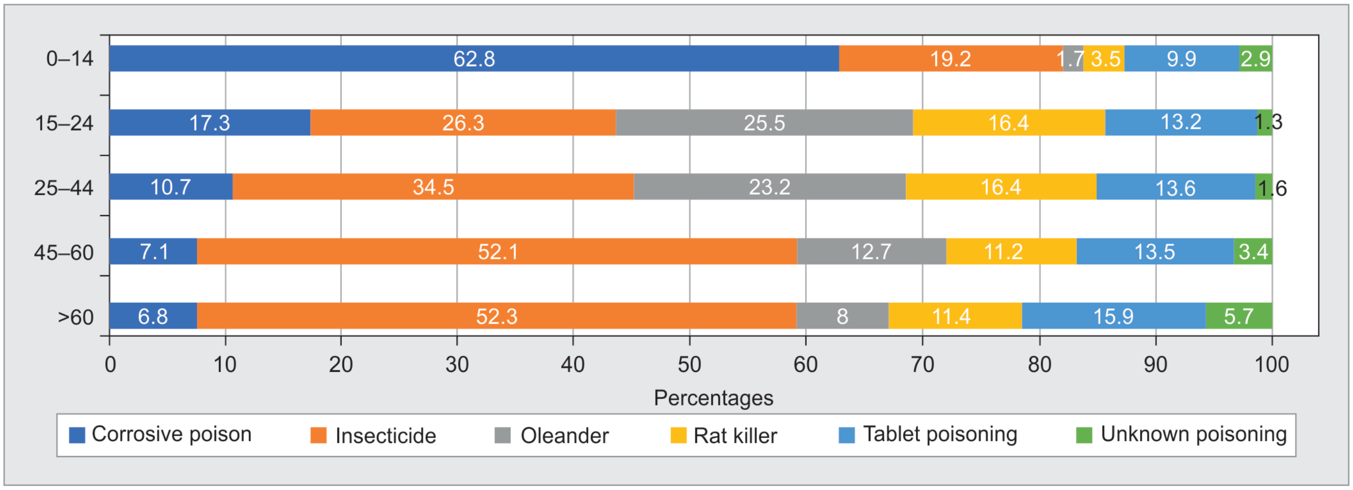

Fig. 2: Profile of poisoning in different age-groups

Table 2: Logistic regression analysis of factors associated with mortality

Parameters	*Unadjusted odds ratio (95% CI)*	*p-value*	*Adjusted odds ratio (95% CI)*	*p-value*
Age-group				
0–14 (*N* = 172)	Baseline		Baseline	
15–24 (*N* = 718)	2.661(0.35–20.75)	0.350	0.123 (0.01–8.25)	0.329
25–44 (*N* = 878)	7.949 (1.09–58.26)	0.041	0.254 (0.01–16.22)	0.518
45–60 (*N* = 267)	31.023 (4.23–227.77)	<0.001	2.499 (0.04–161.22)	0.667
>60 (*N* = 88)	43.972 (5.76–335.74)	<0.001	3.368 (0.05–243.57)	0.578
Gender				
Male (*N* = 1198)	2.903 (1.831–4.603)	<0.001	1.011(0.27–3.81)	0.988
Female (*N* = 925)	Baseline		Baseline	
Type of poison				
Corrosive poison (*N* = 351)	Baseline		Baseline	
Insecticide (*N* = 710)	24.369 (5.97–99.6)	<0.001	1.31(0.09–19.3)	0.844
Oleander (*N* = 431)	1.635 (0.3–8.98)	0.572	6.001(0.19–196.03)	0.314
Rat killer (*N* = 308)	5.253 (1.13–24.50)	<0.001	12.128 (0.51–290)	0.123
Tablet poisoning (*N* = 281)	1.884 (0.32–11.35)	0.49	0.043 (0.01–1.49)	0.081
Unknown poisoning (*N* = 42)	23.582 (4.42–125.83)	<0.001	8.606 (0.08–927.74)	0.367
GCS	0.339 (0.29–0.4)	<0.001	0.271(0.2–0.38)	<0.001
Time B/T intake and admission				
≤1 hour (*N* = 453)	Baseline		Baseline	
1.01–3 hours (*N* = 818)	2.175 (1.11–4.27)	0.024	3.094 (0.68–14.14)	0.145
3.01–12 hours (*N* = 815)	2.795 (1.45–5.41)	0.002	2.721 (0.61–12.22)	0.191
>12 hours (*N* = 37)	4.871(1.47–16.14)	0.000	0.213 (0.02–4.37)	0.315

gender and poison exposure as well as to develop effective prevention strategies and interventions for both men and women.

In the current study, pesticide consumption contributed to about one-third of poisoning among the overall population. This is in line with the study conducted by Ahuja et al., where pesticide was commonly employed among half (53.7%) of the study population.[22] Oleander, corrosive, and rat killer were other common modes. In the pediatric population, corrosive poisoning is the most common mode. These results are contrary to the study conducted by Singh et al., where drug consumption (46.4%) is the most common form of poisoning when compared with ingestion of pesticides (4.3%).[23] Tablet consumption ranks as the second most common contributing factor among women. According to several studies published from various parts of India and neighboring countries, pesticides are the most frequently used poisoning agents.[2,9,24–26] Hair dye and other household chemicals are merging as an important contributors in recent years.[4] But there are wide variations in the relative percentage ranging from as low as one-fourth to as high as two-thirds of overall poisoning cases.[25,27] There are very few studies that have reported a higher relative contribution of acute corrosive

Table 3: Factors associated with deaths due to poisoning

Parameters	Treatment outcome: Discharged (Survived during the period of stay)	Treatment outcome: Expired	p-value
Age-group			
0–14 ($N = 172$)	171 (99.42%)	1 (0.58%)	<0.001
15–24 ($N = 718$)	707 (98.47%)	11 (1.53%)	
25–44 ($N = 878$)	839 (95.56%)	39 (4.44%)	
45–60 ($N = 267$)	226 (84.64%)	41 (15.36%)	
>60 ($N = 88$)	70 (79.55%)	18 (20.45%)	
Gender			
Male ($N = 1,198$)	1,112 (92.82%)	86 (7.18%)	<0.001
Female ($N = 925$)	901 (97.41%)	24 (2.59%)	
Type of poison			
Corrosive poison ($N = 351$)	349 (99.43%)	2 (0.57%)	<0.001
Insecticide ($N = 710$)	623 (87.75%)	87 (12.25%)	
Oleander ($N = 431$)	427 (99.07%)	4 (0.93%)	
Rat killer ($N = 308$)	299 (97.08%)	9 (2.92%)	
Tablet poisoning ($N = 281$)	278 (98.93%)	3 (1.07%)	
Unknown poisoning ($N = 42$)	37 (88.1%)	5 (11.9%)	
GCS	14.78 ± 0.89	7.26 ± 1.14	<0.001
Time B/T intake and admission			
≤1 hour ($N = 453$)	442 (97.57%)	11 (2.43%)	0.006
1.01–3 hours ($N = 818$)	776 (94.87%)	42 (5.13%)	
3.01–12 hours ($N = 815$)	762 (93.5%)	53 (6.5%)	
>12 hours ($N = 37$)	33 (89.19%)	4 (10.81%)	

and drug overdose as compared with pesticide poisoning.[28] These variations can be attributed to differences in the sociodemographic composition of the population studied study setting, accessibility to poisonous substances, etc.

In the current study, close to 40% of the affected patients reached the hospital beyond 3 hours. The mean GCS score was 14.39 ± 1.89 (range 3–15) in the study population. The mean duration of hospital stay was 2.33 days, ranging between 1 and 33 days. Among the study population, the CFR was 5.2%. An Indian study reported an average hospital stay of 12.53 ± 7.53 days, 8.31% CFR.[5] As per another study, the mean duration of hospital stay was 7.5 days with a CFR of 9.9%.[12] As per another study from West Bengal, the percentage of non-survivors was 15.3%. Another study reported a 17.3% CFR with an average hospital stay of 2 days.[25] Wide variations in the reported CFR can be attributed to a multitude of factors, such as differences in age composition, type of poison, locality of the hospital, etc. Also, there are variations in dealing with the left against medical advice (LAMA) cases while calculating CFR, with few studies including and others excluding them from the overall calculation.

In the current study on inferential analysis, Mortality was highest among more than 60-year ager, among males, and among insecticide poisoning. Case fatality rate has shown an increasing trend with increasing time between consumption and treatment. To calculate time of presentation, information on exact time of consumption and exact time of referral were taken from the referral sheets from secondary care centers. But in multivariate analysis, GCS score at admission was the only independent predictor of mortality. There are very few studies in the past that have attempted to analyze factors associated with mortality. Some of the predictors of mortality reported were intentional poisoning,[15] type and dose of poison.[4] Referral cases, residence,[9] male gender,[28] etc. Distance from the hospital and time taken to reach the hospital were also reported to influence mortality, which was different from the current study. According to some studies, none of the included parameters were associated with mortality.[29] Similar to the current study, low sensorium at presentation was found to be strongly associated with a higher risk of mortality.[30] Some studies have calculated structured risk scores like APACHE II and SOFA scores and found them to be strong predictors of mortality.[22] In this study, though severity of illness is measured using qSOFA scale, it is not interpreted in the results section. Overall assessment of existence evidence on factors associated with mortality shows no consistency in the combination of risk factors included in the final analysis.

There are many public health measures that are undertaken by global and national agencies. The Indian government outlawed 18 pesticides between 2018 and 2020.[31] Continued global regulation of pesticides, over the counter pharmaceuticals, including banning some of the most toxic pesticides like paraquat is the need of the hour. Increased investment in sustainable agriculture practices that prioritize the use of non-toxic alternatives to highly hazardous pesticides, as well as education programs aimed at promoting safe and responsible pesticide use among farmers, are also needed. Also, there is a need for consistency across the studies in the assessment of key factors at admission, which can influence mortality, for effective risk stratification and appropriate management.

Conclusion

Acute poisoning primarily affects the young and economically productive population. Pesticides are still the major contributor though corrosives and are a major contributor among children. There is disproportionate involvement of the male gender. Mortality is still significant, and GCS status admission is the only predictor of mortality. More robust scientific research and real-world evidence studies, pooling data from multiple centers across the country are need of the hour. There is also a need for a wide range of policy, regulatory, educational, and healthcare improvement initiatives involving all key stakeholders. These stakeholders can be global and national governments, regulatory agencies, healthcare providers, civil society organizations, etc.

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Authors’ Contributions

Author Latha Durai has conceptualized the study and played primary role in compiling, analysis and interpretation of the data.

All the drafts were prepared, reviewed, and final draft was approved by Narayanasamy Krishnasamy, Narmadhalakshmi R, Parameshwari P, Jayalakshmi R, Lokesh R, Jayanthi R, Latha Durai, Murali Mohan Reddy G. Authors Narayanasamy Krishnasamy, Narmadhalakshmi R, Parameshwari P, Jayalakshmi R, Lokesh R, Jayanthi R, Latha Durai, Murali Mohan Reddy G have contributed in fine-tuning of the proposal, contributed in data collection and entry. Reviewed the results and contributed to preparation and review of drafts. All the authors have read and approved the final version of the manuscript. All the authors take complete responsibility for the content of the manuscript.

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