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An Assessment Of Water Chemistry And The Ichthyofaunal Diversity Of Ratabeel Wetland In Karimganj District Of Assam: A Case Study.

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Abstract

The present assessment was intended to investigate the diversity of fish species and physico-chemical parameters of Ratabeel wetland located within a geographical location of 22^0 54' 19.5" N and $92^0$27' 48.4" E in Karimganj district of Assam. The physico-chemical parameters include Air Temperature (AT), Water Temperature (WT), Turbidity, pH, Dissolved Oxygen (DO), Free Carbon-di-Oxide (FCO_2), Total Alkalinity (TA), Total Hardness (TH), Conductivity (Cndvty), Nitrate (NO_3), Phosphate (PO_4) etc. and were estimated by following standard procedure of American Public Health Associatio (APHA). During the study period, the fish species were collected by using different experimental fishing gears such as a variety of traps, cast nets, gill nets, drag nets, triangular scoop nets etc. and then identified by following standard literature and keys. During the assessment period the values of physic-chemical parameters were found to be within the range of WHO standards portraying the better condition of the habitat for the fishes. The ichthyofaunal diversity study of the wetland revealed 43 species of fishes belonging to 35 genera, 14 families and 7 orders. Among them the fishes of the order cypriniformes (48%) were found to be abundant followed by Siluriformes (27%), Perciformes (15%), Osteoglossiformes (4%), Clufiformes (2%), Synbranchiformes (2%) and Beloniformes (2%).

Keywards: Abundant, assessment, fish diversity, habitat, physico-chemical. Ratabeel

INTRODUCTION

Freshwater biodiversity constitutes a vitally important component of our planet, with a species richness that was relatively higher compared to both terrestrial and marine ecosystems (Kar, 2007). The freshwater ecosystem supports various orders of animals, plants and fungi contributing to a big portion of the biota consisting of animals, plants and microbes. freshwater ecosystems may broadly be categorized divided into two categories, *viz.*,the lentic ecosystem and the lotic ecosystem. the occurrence of fishes is closely associated with the structural features of the lotic environment. From the earlier times, habitat features like substrate type, water current, depth etc., were considered as important factors in determining the distribution and abundance of fishes; and hence, the fishery biologists have a major concern on the importance of habitat and the relationship between the fish and habitat.

The dependence of man on the biological wealth of lakes, wetlands, rivers, oceans etc., could not be over emphasized. But the fast expansion of individual inhabitants and increased demand for water and its bio-resources had been resulting in further loss of stream habitat which had lead to aquatic organisms becoming

less abundant. In order to discontinue further dreadful conditions of the fragile ecosystem, there was a need of integrated and accelerated effort towards ecological renovation and conservation (Kar *et al.,* 2003 a; Kar, 2007; Kar, 2013).

Freshwater biodiversity constitutes a vitally important component of our planet, with a species richness that was relatively higher compared to both terrestrial and marine ecosystems (Kar, 2007). The freshwater ecosystem supports various orders of animals, plants and fungi contributing to a big portion of the biota consisting of animals, plants and microbes.

India is one of the Mega biodiversity countries in the World and occupies 9th position in terms of freshwater Mega biodiversity (Goswami and Goswami, 2006). In 6 India, there are *c* 2500 species of fishes; of which, *c* 930 live in freshwater (FW) and *c* 1570 are marine (Kar, 2003, 2007). The bewildering biodiversity of North-Eastern region has been attracting many ichthyologists both from India and abroad.

Concomitantly, North-Eastern region of India has been identified as a `Hotspot' of Biodiversity' by the World Conservation Monitoring Centre (WCMC, 1998). This rich diversity of the region can be assigned to certain reasons, notably, the geomorphology and the tectonics of this zone. The hills and the undulating valleys of this area give rise to large number of torrential hill streams, which lead to big rivers; and, finally, become part of the Ganga-Brahmaputra-Barak-Chindwin-Kolodyne-Gomati-Meghna system (Kar, 2000, 2007, 2013).

Fishes are primarily adapted, cold blooded, aquatic vertebrates which breathe by means of pharyngeal gills, propelling and balancing themselves by means of fins. They make up most of the abundant class of vertebrates, both in terms of number of species and of individuals.

Fishes have great significance in the life of mankind, and, are the staple food item in the diet of many consumers throughout the world. They form an important economy of many nations and give incalculable recreational value to the naturalist, sports enthusiast and home aquarist. Fishes play important role directly or indirectly in the heritage of human beings. At the same time, the explosion of human population and increased demand for water and its bio-resources have been resulting in further loss of stream habitat that leading to aquatic organism becoming less abundant particularly the fisheries resources. Integrated and accelerated efforts are essential towards environmental restoration and preservation in order to stop further degradation of these fragile ecosystems (Kar *et al.,* 2003 b; Kar, 2007; Kar, 2013).

Notwithstanding the above, a lack of in depth study on the essential physical, chemical and biological parameters of Ratabeel wetland in Karimganj district of Assam open up a scope of research to investigate the environmental condition of the water body for sustainable development. This assessment was carried out from 2021 to 2024 with an aim to develop a brief structure of the present scenario of physicochemical parameters and freshwater fishery resources.

MATERIALS AND METHODOLOGY

1.STUDY SITE

The Ratabeel wetland is located within a geographical location of 22^0 54' 19.5" N and $92^0$27' 48.4" E in Karimganj district of Assam. It is about 25 km away from Karimganj city via Badarpur Junction in Barak valley region. The wetland remains connected with one of the Largest wetland of India the Sone Beel during summer and separated by Kachua river during winter season in its southern part. the wetland is surrounded by Khagail Pt II in the North, Mahamadpur Part I in the south, Maizbagargool in the East and Khagail Pt III in the west. The Ratabeel is said to be the foundation pillar of the fishermen economy of the stakeholders because of its fishery resources and plays an important role in the region's ecological and socio-economic landscape.

2.PHYSICO-CHEMICAL PARAMETERS

The physico-chemical parameters, such as, Air Temperature (AT), Water Temperature (WT), Turbidity, pH, Dissolved Oxygen (DO), Free Carbon-di-Oxide (FCO2), Total Alkalinity (TA), Total Hardness (TH), Conductivity (Cndvty), Nitrate (NO3) and Phosphate (PO4) were estimated after APHA (1995, 1998, 2010).

In the field, temperature was measured with the help of a Mercury-in-glass celsius thermometer; pH was measured with the Qualigens-make Indikrom wide range pH-papers (pH 2.0-10.5), turbidity was measured with help of standard turbidity rod. In the laboratory, pH was measured with Systronics made digital pH meter Type-335, turbidity was measured with Systronics made digital Nephelo-Turbidity meter Type-131, conductivity was measured with Systronics made D.D.R. Conductivity pH meter Type-335, D.O. was measured with both Systronics made digital Dissolved Oxygen meter Type-312 and Winkler's Iodometric titration method (Welch (2003), FCO2 and T.A. were also measured with the Titration method of Welch

(2003) using Phenolphthalein and Methyl Orange as indicators. Phosphate was measured with Stannous Chloride method (APHA, 1998, 2010) and nitrate was measured with the Brucine method (APHA, 1998, 2010) using Systronics made Spectrophotometer Type-105.

3.FISH SAMPLING, PRESERVATION AND IDENTIFICATION

General survey of the fish biodiversity was done using standard procedures (Armontrout, 1990). Fish samples were collected from the sampling sites through experimental fishing; using cast nets (dia.3.7 m and 1.0 m), gill nets (vertical height 1.0 m- 1.5 m; length 100 m -150 m), drag nets (vertical height 2.0 m), triangular scoop nets (vertical height 1.0 m) and a variety of traps and with hook and lines in certain places (where netting is not possible).

Fish species had been preserved, at first, in concentrated Formaldehyde in the field. After that, the fishes were transferred to laboratory and preserved in 10 % formalin. The small size fishes were preserved in 5% aqueous formalin solution and big size fishes in 10% aqueous formalin solution and kept in the air-tight plastic bottles.

In the laboratory, the fishes were identified by following standard literature, notably, Day (1873, 1878, 1885, 1889), Misra (1976), Roberts (1978, 1989), Rainboth (1996), Sen (1982, 1985, 2000), Talwar and Jhingran (1991), Jayaram (1981, 1999, 2010), Nath and Dey (1997, 2000), Vishwanath (2000, 2002), Vishwanath and Singh (1986, 1987), Vishwanath and Sarojnalini (1988), Vishwanath and Kosygen (1999, 2000a, 2000b. 2001), Vishwanath and Linthoigambi (2007), Vishwanath *et al.* (1987, 1998 2007) and Kar (2007, 2013) and www.fishbase.org.

4.MEASUREMENT OPF BIODIVERSITY

Shannon-Weiner Index (H/) (Shannon-Weiner, 1949); Simpson index of diversity (1-D); Simpson dominance index (D); Species richness; species evenness (Pielou, 1966) etc. have been described for analyzing the species diversity.

5.SOFTWARE USED

a. Microsoft Office word 2007 and 2010: Used basically for the Text typing, Graph preparation and Statistical Analysis.
b. GPS Garmin Software for input of of latitude and longitude in the map.
c. SPSS 19: Statistical Analysis.
d. Microsoft Office Excel 2007, Microsoft Office PowerPoint 2007.

RESULTS AND DISCUSSION

A. WATER CHEMISTRY OF RATABEEL

The water samples were collected from different sampling sites of the wetland during pre-monsoon, monsoon and post monsoon seasons of the study period from 2019-2021. The analysis of some of the parameters were carried out in the sampling site itself and others were done in the laboratory. The average values of the different parameters of water chemistry of the wetland of three different seasons from 2019-2021 have been presented in the Table 1. From the observation, it has been found that, AT and WT ranged from 20±1.18^{0}C to 34.5±0.50^{0}C and 17±0.60^{0}C to 24.3±0.50 ^{0}C respectively. pH and TA fluctuated between 6.58±0.10 to 7.88±0.11 and 32±1.48 mg/L to 55.4±0.72 mg/L respectively. The value of DO and FCO_2 portrayed a range of 6.12±0.12 mg/L to 9.12±0.17 mg/L and 1.48±0.11 mg/L to 3.44±0.11 mg/L respectively. The TU and Transparency value has been recorded within the limit of 37±0.70 NTU to 78.4±1.36 NTU and 18.65±0.66 cm to 28.2±1.1 cm respectively. TH and conductivity of water depicted a range of 37.2±0.4 mg/L to 62.3±0.71 mg/L and 94.2±0.81 µmohs/cm to 165.3±1.48 µmohs/cm respectively. In addition, the value of nitrate and phosphate has been recorded as 0.087±0.00 mg/L to 0.343±0.01 mg/L and 0.27±0.01 mg/L to 0.496±0.02 mg/L respectively.

Physico-chemical characteristics of water varied according to seasons. Most of the water parameters varied seasonally. Concentrations of nutrients like nitrite, phosphates etc. were within permissible limits (Table 1). The air temperature in river water was largely regulated by solar radiation and topography and the recorded AT and WT were ranging from 20 ± 1.18°C (post-monsoon) to 34.5 ± 0.50°C (Monsoon) and 17 ± 0.60°C (post-monsoon) to 24.3 ± 0.50°C (monsoon) respectively. The Temperature of the water regulates the concentration of the DO and primary productivity which in turn causes a great variability in distribution of plants and animals. The values of DO, pH, FCO_2 , TA, TH, TU, Conductivity, Nitrate, Phosphate etc were

recorded to be within the range of WHO standards as shown in Table 1 which indicates a better habitat for growth and development of the aquatic plants and animals.

Parameters	Pre-monsoon	Monsoon	Post-monsoon	WHO Standards
AT (^{0}C)	34.5±0.50	32.6±1.96	20.2±1.18	-
WT(^{0}C)	24.5±0.58	24.3±0.50	17±0.60	-
pH	7.06±0.24	7.88±0.11	6.58±0.10	6.5-8.5
DO (mg/L)	6.12±0.12	9.12±0.17	7.18±0.05	5-8
FCO_2(mg/L)	3.44±0.11	1.48±0.11	2.68±0.16	22 max
TA(mg/L)	42.2±1.39	55.4±0.72	32±1.48	200 max
TU(NTU)	54.65±0.75	78.4±1.36	37±0.70	100 max
Transparency (cm)	25.6±0.92	18.65±0.66	28.2±1.1	
TH(mg/L)	37.2±0.4	62.3±0.71	44.2±0.73	300 max
Conductivity (µmohs/cm)	148.6±1.02	165.3±1.48	94.2±0.81	50-1500
Nitrate(mg/L)	0.087±0.00	.343±0.01	0.18±0.00	10
Phosphate(mg/L)	0.27±0.01 mg/L to	0.446±0.01	0.496±0.02	10

Table 1. Mean values of Physico-chemical parameters of water of Ratabeel wetland in different seasons during study period. (mean ± SE, n=5)

B. Ichthyospecies Diversity of Ratabeel:

During the study period, altogether 43 species of fishes belonging to 35 genera, 14 families and 7 orders have been identified from the wetland (Table 2). Among them the fishes belonging to the order Cypriniformes (48%) were recorded as the most abundant followed by Siluriformes (27%), Perciformes (15%), Osteoglossiformes (4%), Clufiformes (2%), Synbranchiformes (2%) and Beloniformes (2%). Familywise abundance of fishes portrayed highest value for Cyprinidae followed by bagridae and sisoridae, followed by cobitidae, siluridae and channidae, notopteridae and chandidae. Incidentally, clupeidae, belonidae, mastacembalidae, and gobiidae reflected very less abundant (Fig. 2).

Sl. No.	**Order**	**Family**	**Scientific name**	**Conservation Status (IUCN)**
1	Osteoglossiformes	Notopteridae	*Notopterus notopterus (Pallas, 1769)*	LC
2			*Chitala chitala* (Hamilton Buchanon, 1822)	NT
3	Clupeiformes	Clupeidae	*Gudusia chapra* (Hamilton-Buchanan, 1822)	LC
4	Cypriniformes	Cyprinidae	*Salmophasia bacaila* (Hamilton-Buchanan, 1822)	LC
5			*Cabdio morar* (Hamilton-Buchanan, 1822)	LC
6			*Barilius bendelisis* (Hamilton-Buchanan, 1807)	LC
7			*Barilius barna* (Hamilton-Buchanan, 1822)	LC
8			*Devario aequipinnatus* (McClelland, 1839)	LC
9			*Amblypharyngodon mola* (Hamilton-Buchanan, 1822)	LC
10			*Neolissochilus hexagonolepis* (McClelland, 1839)	NT
11			*Puntius ticto* (Hamilton-Buchanan, 1822)	LC
12			*Pethia conchonius* (Hamilton-Buchanan, 1822)	LC

13			*Cirrhinus mrigala* (Hamilton-Buchanan, 1822)	LC
14			*Catla catla* (Hamilton-Buchanan, 1822)	LC
15			*Labeo rohita* (Hamilton-Buchanan, 1822)	LC
16			*Labeo gonius* (Hamilton-Buchanan, 1822)	LC
17			*Labeo calbasu* (Hamilton-Buchanan, 1822)	LC
18			*Crossocheilus latius* (Hamilton-Buchanan, 1822)	LC
19			*Garra lissorhynchus* (McClelland, 1842)	LC
20		Cobitidae	*Botia dario* (Hamilton-Buchanan, 1822)	LC
21			*Botia rostrata* (Hamilton-Buchanan, 1822)	VU
22			*Lepidocephalichthys guntea* (Hamilton-Buchanan, 1822)	LC
23	Siluriformes	Bagridae	*Rita rita (Hamilton-Buchanon, 1822)*	LC
24			*Mystus cavasius* (Hamilton-Buchanan, 1822)	LC
25			*Mystus bleekeri* (Day, 1877)	LC
26			*Sperata seenghala (Sykes, 1839)*	LC
27		Siluridae	*Ompok bimaculatus* (Bloch, 1794)	NT
28			*Ompok pabda* (Hamilton-Buchanon, 1822)	NT
29			*Wallago attu* (Bloch and Schneider, 1801)	NT
30		Schilbeidae	*Ailia coila (Hamilton-Buchanan, 1822)*	NT
31			*Eutropiichthys vacha* (Hamilton-Buchanan, 1822)	LC
32		Sisoridae	*Gagata gagata* (Hamilton-Buchanan, 1822)	LC
33			*Gagata cenia* (Hamilton-Buchanan, 1822)	LC
34			*Erethistes pusillus* Muller and Troschel, 1849	LC
35			Glyptothorax annandalei Hora, 1923	LC
36	Beloniformes	Belonidae	*Xenentodon cancila* (Hamilton-Buchanon, 1822)	LC
37	Synbranchiformes	Mastacembelidae	*Mastacembelus armatus* (Lacepede, 1800)	LC
38	Perciformes	Chandidae	*Chanda nama* (Hamilton-Buchanon, 1822)	LC
39			*Parambassis ranga* (Hamilton-Buchanan, 1822)	LC
40		Nandidae	Badis badis (Hamilton-Buchanan, 1822)	LC

41		Belontidae	*Trichogaster fasciata* (Bloch and Schneider, 1801)	LC
42		Channidae	*Channa punctata* (Bloch, 1793)	LC
43			*Channa striata* (Bloch, 1793)	LC

Table 2. Ichthyospecies diversity and the conservation status of the fishes of Ratabeel wetland.

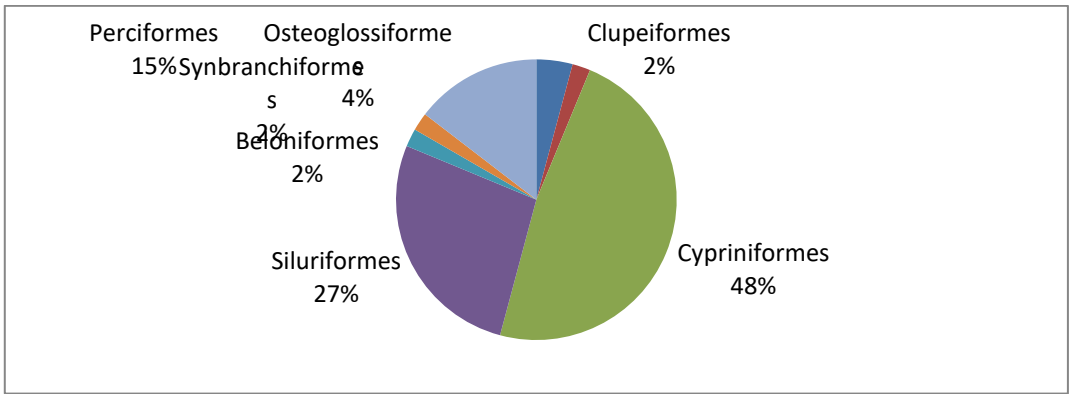

Figure 1.Relative abundance of fishes of Ratabeel wetland.

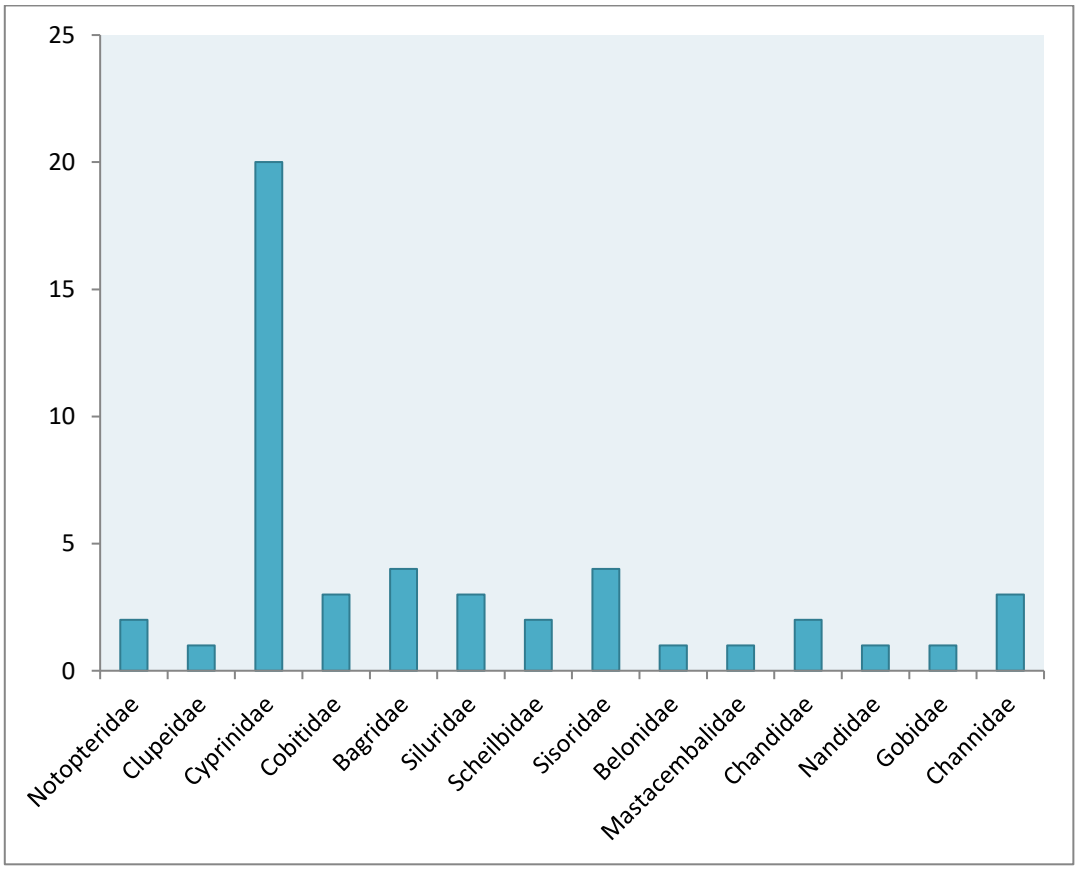

Figure 2. Distribution of fishes of Ratabeel wetland.

Correlation between the Physico-chemical parameters with the fish diversity of Ratabeel

Pearson's correlation coefficient between physico-chemical parameters of water of the studied wetland in maximum cases revealed a positive correlation of DO with AT, WT, pH, TA, TU, TH, nitrate, fish yield and negatively correlation with the FCO_2, transparency, phosphate; FCO_2 is found to be negatively correlated with pH, TA, TU, TH, Conductivity and fish yield (Table 4) .

	AT	WT	pH	DO	FCO_2	TA	TU	Transp	TH	Conductivity	Nitrate	Phosphate	Fish species
AT													
WT	0.99**												
pH	1	0.98*											
DO	0.89	0.94	0.86										
FCO_2	-0.63	-0.73	-0.59	-0.92									
TA	1.00**	1.00**	0.99**	0.92	-0.69								
TU	0.87	0.93	0.84	1.00**	-0.93	0.9							
Transp	-0.99**	-0.96*	-1.00**	-0.82	0.52	-0.98*	-0.79						
TH	0.65	0.55	0.61	0.93	-1	0.71	0.94	-0.54					
Conducti	0.43	0.55	0.38	0.79	-0.97*	0.5	0.82	-0.3	0.96*				
Nitrate	1.00**	1.00**	0.99**	0.92	-0.69	1.00**	0.9	-0.98*	0.71	0.5			
Phosphate	-0.72	-0.61	-0.75	-0.32	-0.09	-0.66	-0.27	0.81	0.06	0.32	-0.66		
Fish species	1.00**	1.00**	0.99**	0.91	-0.67	1.00**	0.89	-0.98*	0.69	0.47	1.00**	-0.68	

Figure 4. Correlation between the Physico-chemical parameters with the fish diversity of Ratabeel.

***correlation is significant at .05 (2 tailed) level and **correlation is significant at .01 (2 tailed) level.**

CONCLUSION

The present investigation was carried out on river Karnafuli in Mizoram, India during 2014-2019 covering three seasons, *viz.*, pre-monsoon, monsoon and post-monsoon. The study revealed a detailed account of the physico-chemical characteristics of water, habitat type, fish diversity and species richness. The physico-chemical parameters such as AT, WT, pH, DO FCO_2, TA ,TU, Conductivity, TH, Nitrate, Phosphate and transparency were found to be in optimum level according to WHO standards and resulting in good indication for the aquatic productivity. Fish diversity of the Ratabeel wetland revealed maximum abundance of fishes belong to the order cypriniformes followed by siluriformes, perciformes, osteoglossiformes, clupeiformes, beloniformes and synbranchiformes. The habitats of the studied wetland, on the average, found to be favourable for the fishes on an overall basis. However, application of effective management practices by efficient management *modus operandi*, notably, the community-based fisheries management (CBFM) could lead to better conservation of the water body and the fishes.

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AUTHOR CONTRIBUTION

The first author designed the study, collected data, performed analysis of the data, wrote the protocol and wrote manuscript. The second author helped in statistical analysis, manuscript preparation and in literature searches. Both the author read and approved the final manuscript.

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