AN EPIDEMIOLOGICAL STUDY TO IDENTIFY HIGH RISK AREAS OF MALARIA IN VISAKHAPATNAM DISTRICT OF ANDHRA PRADESH, INDIA, 2017-2019

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ABSTRACT

Malaria is a life-threatening disease spread to humans by some types of mosquitoes. It is mostly found in tropical countries. It is preventable and curable. Malaria mostly spreads to people through the bites of some infected female *Anopheles* mosquitoes. Blood transfusion and contaminated needles may also transmit malaria. Andhra Pradesh is endemic for Malaria. This study aimed to identify high risk areas of malaria in Visakhapatnam district of Andhra Pradesh, India, 2017-19. Geographical data was collected from the District Malaria Office, Meteorological Department (M.D), Municipal Corporation, Government and Census office. Socio economic data was collected from the state census, Department of Statistics and Social Welfare Board (DSSWB). The periodical results were compared and analysed with SPR and PF%.
(Index terms: Anopheles, SPR: Slide Positivity Rate Pf%: Plasmodium falciparum)

I. INTRODUCTION

Malaria is a complex disease and various factors influenced by human activities and natural calamity.in urban areas, risk factors that may be different to those in rural areas lead to different disease burdens. However, in the 1970s a resurgence of malaria was observed peaking with 6.46 million reported cases in 1976. In response, the Modified Plan of Operation was launched in 1977 and monitoring of P. falciparum sensitivity to anti-malarial drugs was initiated. Since then, the incidence of malaria has stabilized with approximately 2 million cases annually. In 2016, 1.76 million cases and 1,679 deaths were reported 2016 to 2019 included. The implementation of control measures under the National Malaria Eradication Programme (NMEP) brought down malaria incidence markedly by 1963 and at the same time an increasing trend of malaria was observed in some towns/cities. 10 urban areas in Andhra Pradesh and Tamil Nadu contributed 11% of the malaria cases in the two states during 1963.Andhra Pradesh is second position urbanized states in India as per the 2001 census; the rate of urbanization is 27.08% which is only higher than Maharashtra and Uttar Pradesh among the major states. Andhra Pradesh is endemic for Malaria. The problem of Malaria can be divided into Rural, Urban and Tribal Malaria. Rural areas contribute 47.4%, Tribal belt contributes 42% and urban areas contribute up to 10.6%. Visakhapatnam, East Godavari, Krishna, Srikakulum, Vizianagaram, Kurnool, West Godavari, Prakasam and YSR Kadapa districts contribute 88% of total cases in the state.

Visakhapatnam city is highly urbanized with a population of around 40 lakhs is in the north of Visakhapatnam District of Andhra Pradesh. The Sub urban area is under surveillance under the staff of the malaria unit. Visakhapatnam District is selected as at is a vulnerable district out of 9-districts in Andhra Pradesh state as per the NVBDCP, Delhi. As part of that Rapid diagnostic Kits were distributed in all the tribal PHCs for the easy diagnosis in the villages which were 3 kilometers from PHC Headquarters.
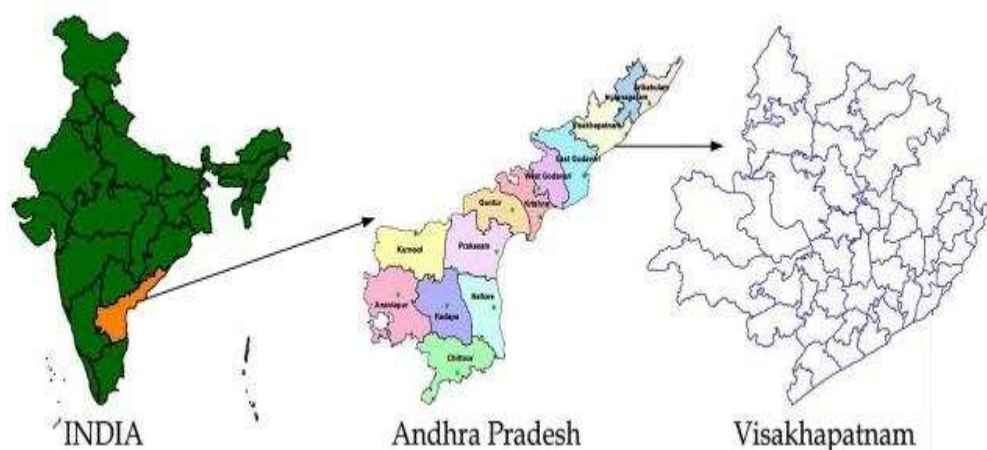

Fig 1: Study area (Visakhapatnam District)

II.   MATERIALS AND METHODS

Collection of data and information:

a) Geographical data was collected from the District Malaria Office (DMO) near Maddilapalem (Visakhapatnam District).
b) Meteorological data like the temperature Collected from the Meteorological Department (M.D).
c) Administrative data was collected from the Municipal Corporation (M.C).
d) Demographic data was collected from the state Government and Census office.
e) Socio economic data was collected from the state census, Department of Statistics and Social Welfare Board (DSSWB).

III. RESULTS:

Table – 1:   Urban malaria situation towns under ums

Year	Population	Total Cases	Pf	Pf %	SPR	SFR	Deaths
2014	10,24,23,064	1,35,249	14,905	11.02	2.33	0.26	196
2015	10,57,82,505	1,29,531	17,278	13.34	2.07	0.28	145
2016	11,24,48,027	1,02,829	18,038	16.82	1.92	0.32	125
2017	11,33,34,073	1,13,810	18,963	13.42	1.66	0.22	102
2018	11,46,99,850	1,66,065	31,134	18.75	2.98	0.56	113
2019	11,51,59,555	1,04,908	7,587	18.75	2.98	0.56	131

The total number of urban malaria cases as compared with total number of cases in the country is depicted in Table -1. The Slide Positivity Rate (SPR) exhibits an increasing trend from 2018-2019. The Pf% low in 2014 (11.02), The SPR and the Pf% was the highest in 2018 (2.98) and in 2018 and 2019 Pf% (18.75) respectively.

Malaria situation in Andhra Pradesh: The malaria situation of Visakhapatnam was analyzed by compiling the secondary data from the state government and comparing the same with our own data obtained through active collection. Visakhapatnam lies under Andhra Pradesh. The data was collected to see the trend of malaria in the comparison to Andhra Pradesh.

Table -2: Comparison of epidemiological situation of malaria in Andhra Pradesh with Visakhapatnam district.

Year	BSE	Positive	Pf	Pf%	SPR%
2015 - Visakhapatnam	1,45,243	1,413	44	3.11	0.97
2015 - Andhra Pradesh	59,59,542	35,093	1,358	3.86	0.58
2016 - Visakhapatnam	1,43,312	1,621	52	3.20	1.13
2016 - Andhra Pradesh	97,98,112	40,123	1,632	4.06	0.40
2017 -Visakhapatnam	1,63,765	1,742	47	2.69	1.06
2017 -Andhra Pradesh	96,91,232	41,315	2,320	5.61	0.42
2018 - Visakhapatnam	1,50,237	1,343	58	4.31	0.89
2018 - Andhra Pradesh	10,50,121	40,001	2,435	6.08	0.39
2019 -Visakhapatnam	1,61,341	1,521	49	3.22	0.94
2019 -Andhra Pradesh	68,69,438	46,326	2,384	5.14	0.67

Table-2 the malaria data of Visakhapatnam, and Andhra Pradesh comparing from 2015-2019 is depicted in the above time period reported, the total cases reported from Visakhapatnam from 2015-2019 is 7640 whereas Andhra Pradesh itself accounts for 20,2858 cases of malaria. This shows that Andhra Pradesh contributes around 6.08% of the malaria cases. The SPR reported from Visakhapatnam shows the highest in 2016 (1.13) and the SPR of Visakhapatnam is nearly two times more than that of Andhra Pradesh but the Pf% of Andhra Pradesh shows an increasing trend from 2015 to 2019 ranging from (3.86 To 6.08). However, Pf% of Visakhapatnam is decreasing by two times ranging from Pf% (3.11 - 3.22)

Table- 3: Month wise spr and pf % of Visakhapatnam in the year- 2017

	B. S. Coll.	Positive Cases			SPR	Pf %
		Pv.	Pf.	Total		
JAN	43,525	84	152	236	0.54	0.34
FEB	49,385	98	154	252	0.51	0.31
MAR	52,163	122	176	298	0.57	0.33
APR	55,179	168	242	410	0.74	0.43
MAY	65,675	172	268	440	0.67	0.40
JUN	68,711	236	333	569	0.83	0.48
JUL	75,777	347	238	585	0.77	0.31
AUG	64,902	350	187	537	0.83	0.42
SEP	57,999	203	132	335	0.58	0.22
OCT	6,10,206	2206	2302	4508	0.74	0.37
NOV	50,518	150	109	259	0.51	0.21
DEC	45,589	84	98	182	0.40	0.21
Total	77,06,313	2440	2509	4949	0.70	0.33

The malaria epidemiological data was collected from all the Government health facilities of Visakhapatnam city and was compiled in the Tables 3, 4, and 5 respectively. Table- 3 depicts the month wise malaria data of -2017. The SPR ranges between 0.40 – 0.83%(Fig.2). The SPR was low in the month of December 0.40, Highest in 0.83 in month of June and Aug. The Pf%(Fig-3) is lowest (0.21) in the month of November and December and highest (0.48) in the month of January.
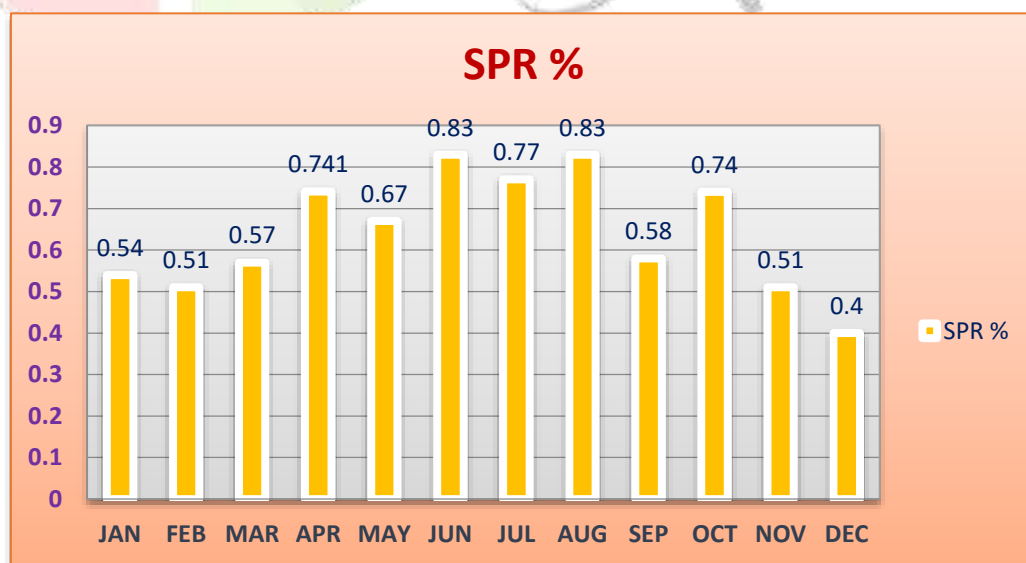

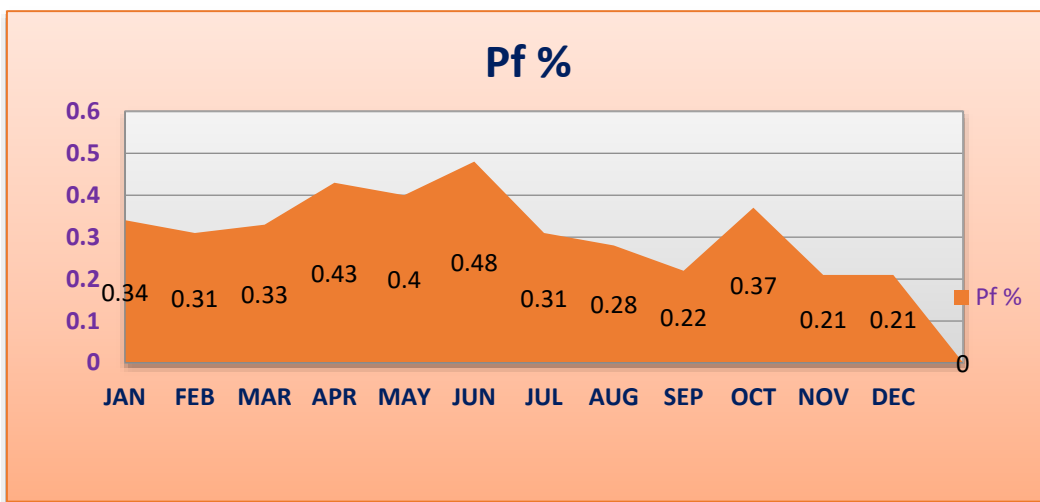**Fig.2. Month wise SPR% of Visakhapatnam in -2017**

Fig.3.Month wise Pf% of Visakhapatnam in 2017

Table -4: Month wise SPR and pf % of Visakhapatnam in year 2018.

Month	2018					
	B.S.Coll.	Positive Cases			SPR	pf %
		Pv.	Pf.	Tot.		
JAN	44,088	95	51	146	0.33	0.11
FEB	46,819	105	73	178	0.38	0.15
MAR	56,109	147	124	271	0.48	0.22
APR	51,960	148	126	274	0.53	0.24
MAY	69,657	243	294	537	0.77	0.42
JUN	79,086	188	391	579	0.73	0.56
JUL	83,460	266	526	792	0.95	0.63
AUG	96,460	474	458	932	0.97	0.47
SEP	10,1216	512	421	933	0.92	0.41
OCT	95,263	255	321	576	0.60	0.33
NOV	58,317	156	220	376	0.64	0.37
DEC	55,827	92	177	269	0.48	0.31
Total	8,38,262	2681	3182	5863	0.70	0.37

The SPR%(Fig:4) was low in January (0.33) and high in August (0.97). In contrast to 2018, and the highest Pf%(Fig.5):was observed in the month of July (0.63) and the lowest in January (0.11). (Table- 5).ThePf% shows a declining trend from July to December.
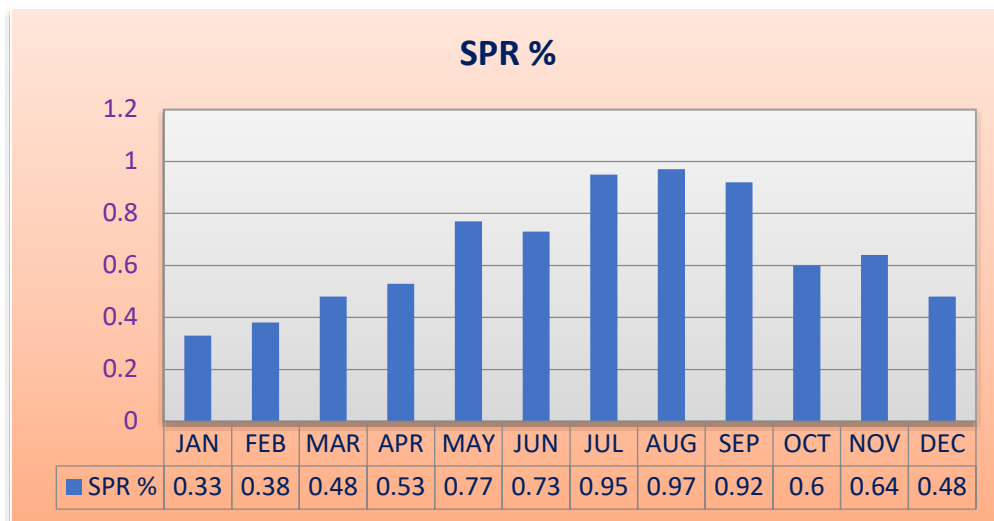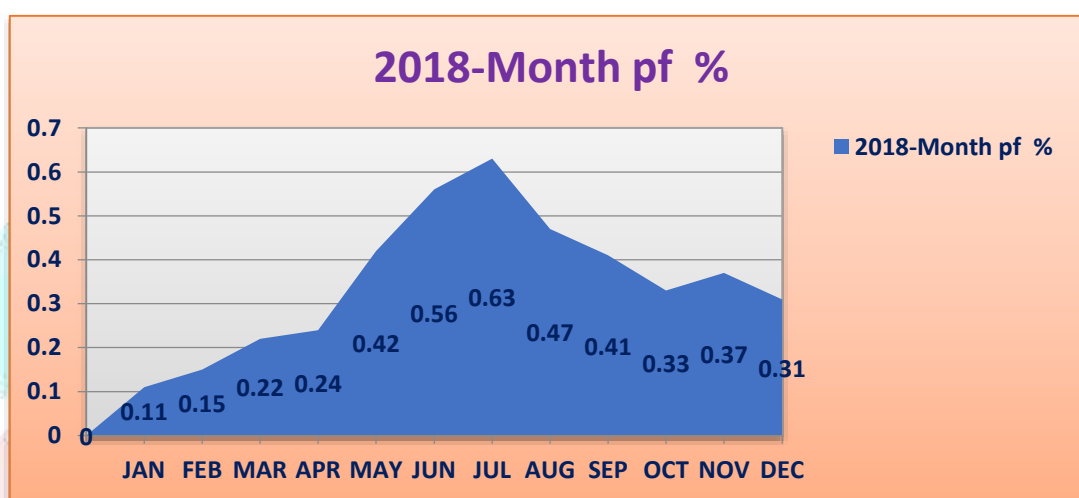
Fig.4. Month wise SPR % of Visakhapatnam in 2018

Fig.5. Month wise Pf% of Visakhapatnam in 2018.

Table- 5: Month wise SPR and pf % of Visakhapatnam in the year -2019

Month	B.S. Collection	Positive Cases			SPR	Pf%
		Pv.	Pf.	Tot.		
JAN	39,795	80	88	168	0.42	0.22
FEB	41,368	78	112	190	0.46	0.29
MAR	45,914	153	251	404	0.88	0.54
APR	53,929	210	471	681	1.26	0.87
MAY	61,044	195	646	841	1.38	1.05
JUN	90,080	246	3970	4216	4.68	4.40
JUL	1,20,366	466	2333	2799	2.15	1.78
AUG	1,09,159	479	940	1419	1.30	0.86

SEP	75,263	252	521	773	1.03	0.69
OCT	64,841	206	368	574	0.89	0.56
NOV	53,845	147	346	493	0.92	0.64
DEC	48,105	82	175	257	0.53	0.36

Table -5 The SPR% (Fig.6)was high in June (4.68) and low in January (0.42). The SPR shows a declining trend from September to December 2019.
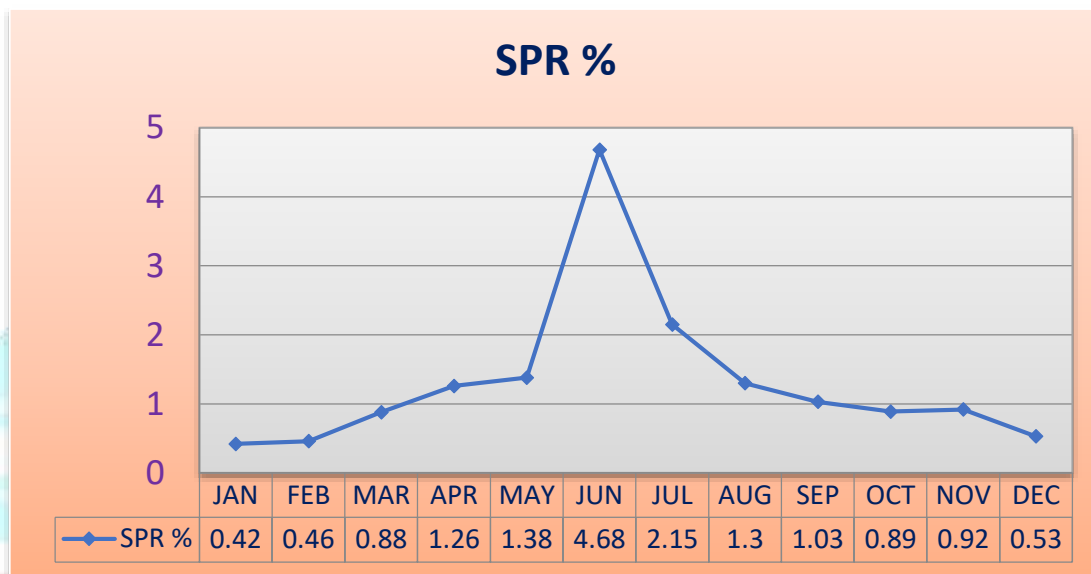

SPR %

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SPR %	0.42	0.46	0.88	1.26	1.38	4.68	2.15	1.3	1.03	0.89	0.92	0.53

Fig.6 : Month wise SPR % of Visakhapatnam in 2019.

2019-Months pf %

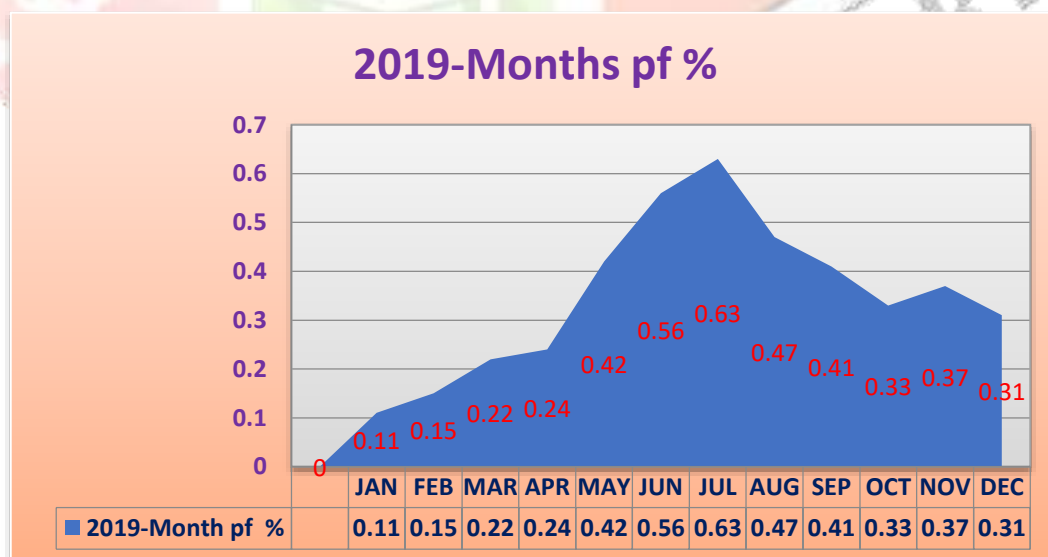|	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2019-Month pf %	0.11	0.15	0.22	0.24	0.42	0.56	0.63	0.47	0.41	0.33	0.37	0.31

Fig.7: Month wise Pf% of Visakhapatnam in 2019.

The demographic data available from Municipal Corporation (MC) reveals the population of the city was 45,74,261 (2019 Census). Morbidity data on malaria was obtained from 5 ecotypes having both slum and non-slum areas by making weekly visit to these areas and collected from fever cases.

Table -6: comparison of SPR and pf% of Visakhapatnam (2017-2019)

YEAR	SPR% Mean ± SD	Pf% Mean ± SD
2017	0.67 ± 0.18	0.340 ± 0.10
2018	0.65 ± 0.21	0.347 ± 0.15
2019	0.34 ± 0.11	3.27 ± 0.15

The comparison of the SPR and Pf% of three consecutive years (2017-2019) has been depicted in Table-6.

DISCUSSION

The malaria incidence in the late 1960s malaria cases in urban areas started to multiply, and upsurge of malaria was widespread. As a result, in 1975, 6.5 million cases were recorded by the National Malaria Eradication Programme (NMEP), highest since resurgence (Githeko and Wamai, 2002) in our study, Table - 2 depicts the malaria incidence data of India from 2005-2019. The total numbers of malaria cases show a decreasing trend whereas the Pf% ranges between 0.75-0.89 million. The number of deaths has increased from 664-1487 in 2015 and again come down gradually by 2019 to767 to which is about 27 times.

The SPR reported from Visakhapatnam shows the highest in 2016 (1.13) and the SPR of Visakhapatnam is nearly two times more than that of Andhra Pradesh but the Pf% of Andhra Pradesh shows an increasing trend from 2015 to 2019 ranging from (3.86 To 6.08). However, Pf% of Visakhapatnam is decreasing by two times ranging from Pf% (3.11 - 3.22).

It was originally thought that Visakhapatnam does not support significant levels of malaria transmission however it was found that this was not true as similar declaration by (Leon *et al*., 2006). From the parasitological survey, 2.8% and 1.8% of the study population were found to be infected in February-March and June-July, respectively. *P.falciparum* was the most common species followed by *P. Vivax and P ovale.* It is known that *P.falciparum*is the most dominant species in Madagascar (Mouchet *et al*., 1993). In our finding the SPR of three consecutive years (2017-2019) was taken into consideration in three different seasons i.e.; winter (November-February), summer (March-June) and rainy season (August-October). The SPR during the summer (March-June) was comparatively higher than the other two seasons in our study period (0.83%, 073%, 4.68%) respectively. It was low in the winter season (0.40%, 033%, 042%).

Our study revealed that maximum and minimum temperature and relative humidity were significantly correlated to SPR at ($p<0.01$). A study carried out by Tong *et al.,* (2003), in China found mean minimum temperature to be more significantly correlated to SPR rather than mean maximum temperature. A rise of temperature, especially minimum temperature in some areas enhances the survival of *Plasmodium* and *Anopheles* during winter and thus accelerates the transmission dynamics of malaria and spreads it into populations that are currently malaria free and immunologically naïve (Loevinsohn, 1994).

The random fever survey in the urban-tribal localities of Visakhapatnam showed that among 3,205 blood slides collected 31.5% tribal and 22% urban were positive for malaria. The Pf% was 59.5% and 40.8% respectively. There was more variation observed between tribal and urban. The remaining 40% and 58.8% of the malaria cases were due to *P.vivax*. A similar study carried out by (Woyessa*etal*., (2004), in Ethiopia showed that the Pv% proceeded over Pf% which was just the reverse of our finding.

Interestingly, when multiple regression was done taking the predictors (temperature and relative humidity) along the malaria incidence, it did not show significant correlation of all the above-mentioned predictors cumulatively on SPR.

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