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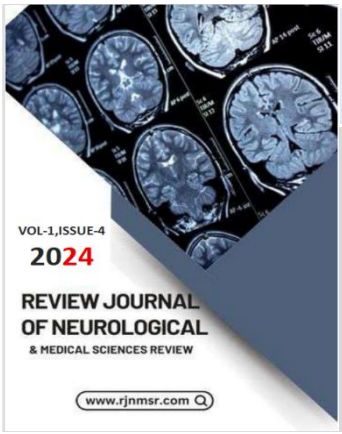
Clinical Burden of Plasmodium (vivax/falciparum) Infection: An Empirical Evidence from Tehsil Kot Addu, Punjab

Ahmad Masood[1]
Scholar BS Nursing, College of Nursing, Kamyab Institute of Medical Sciences, Kot Addu, Pakistan.
Email: ahmadshah8228@gmail.com
Dr. Mashar Hayyat[2]
Principal, Kamyab Institute of Medical Sciences, Kot Addu.
Email: docmash97@gmail.com
Areeba Arooj[3]
Scholar MBBS, Pak Red Crescent Medical and Dental College, Lahore, Pakistan. Email: areebamastoi@gmail.com
Nimra Sardar[4]
Scholar MBBS, Quaid-e-Azam Medical College, Bahawalpur, Pakistan. Email: m.nimra1204@gmail.com

Abstract

Background: Plasmodium infection is a life threatening and serious diseases caused by parasite that is transmitted through the infected female Anopheles mosquito. The most popular species in Kot Addu is vivax and falciparum; these species directly affect the immune system. Objective: the major aim of this study to determine the clinical burden of plasmodium vivax and falciparum in Kot Addu that how it affects. Methodology: The cross-sectional study was conducted in THQ hospital Kot Addu. This was based on primary and secondary data sources and the data was collected from the laboratory of THQ Hospital Kot Addu. The method which was used to diagnose the plasmodium infection is the RDTs and microscopic method. For the analyses of data regression and correlation was conducted by SPSS software. Results: The participants (31) who were diagnosed with plasmodium infection which showed that P.vivax (71%) have more density than the P.falciparum (12.9%) and mixed infection (16.1%). Conclusion: This study demonstrate clinical burden of P.vivax and P.falciparum



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infections in Kot Addu. This also explains the preventive measure to reduce the morbidity and mortality due to malaria.

Keywords: Plasmodium, P.vivax, P.falciparum, Risk factors, Chronic Diseases

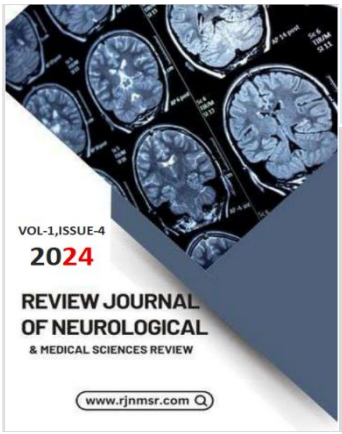
INTRODUCTION

Malaria, is caused due to Plasmodium is a major health problem in the rural areas of the Pakistan. By the efforts of the government of the Pakistan, yet it is a leading cause of morbidity and mortality rate. As it remains a clinical burden on the health care centers of the rural areas of the Pakistan. Poor socioeconomic conditions, lack of accessibility to healthcare services, and poor disease surveillance worsen the effects of the disease This study will evaluate the clinical burden of Plasmodium infection in Kot Addu, Punjab, Pakistan, and assess the related risk factors, health consequences, and economic impacts that may serve as a foundation for evidence-based interventions and policy decisions These parts of the world bear the brunt of its socioeconomic and health costs (Qureshi, Latif, & Muhammad, 2024).

In 2022, the WHO reported that about 249 million cases of malaria in all over the world, resulting in 608,000 deaths worldwide (WHO, 2023). There are almost 150 types of plasmodium is discover worldwide that effects on the healthy life of mammal, reptiles, birds and other organism. (Mustafa, et al., 2024) some plasmodium such as: Plasmodium oval, Plasmodium falciparum, Plasmodium vivax, and Plasmodium knowlesi (a zoonotic illness) are the five primary species that cause malaria in humans, while there are more than 250 species of Plasmodium known to exist. (Khan, Anjum, Quresh, Fatima, & Khan, 2024). Two most prevalent species that cause malaria are Plasmodium vivax and P. falciparum. P. vivax has a wider range of clinical outcomes than P. falciparum, which is linked to chronic diseases and increase mortality and morbidity rate. Geographic range effects due to weather changes such as ending session of winter and summer season (Qureshi, Latif, & Muhammad, 2024)

People who are at high risk of severe illness of malaria are infants, children, pregnant women, older individuals and specially travelers. Travelers of non-endemic regions are susceptible to plasmodium infection since they are typically not immune. So, they get infection as early as in others (Memon, Syed, Tahir, Tahir, & huma, 2024). Some of the consequences of malaria in the pregnant women are low born babies, miscarriage, early death and decreased growth fatal. (Okesanya , Atewologun, Prisno III, Adigun, Oso, & Manirambona, 2024).

Every element of the malarial control, involving funding, advocacy, monitoring progress, specific strategies and resource allocation, are dependent upon accurate epidemiological data regarding the illness burden. (Scott, Hussain, -Hughes, I. Fowkes, Ker, & Pearson, 2017). Special interventions such as: mosquito killing sprays, Bed nets, and Rapid Diagnostic



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Testing (RDTs) by ICT (Immune Chromatography Test) and antimalarial medication increasing the control of burden of malaria. (Baig, Ali, Ahmed, & Jamal, 2024). A key role for the elimination of malaria is diagnosis of malaria, simply microscopy and RDTs by ICT may result in the false positive and false negative due to modification in parasite and low density infection. For the proper diagnosis of malaria, there must be use of proper sensitive and specific methods to get efficient results which leads to proper diagnosis. (Simmons, Sicuri, Carter, Hailu, & Kiemde, 2024).

RESEARCH OBJECTIVES

The major aim of this study is to find the clinical burden of malarial effects in the rural areas such as Kot Addu, especially in the government hospital and to study that how the malarial parasites affects the density of the infection and diseases severity. This study also reads the plasmodium effects which is beneficial and helpful for other policy makers and top management.

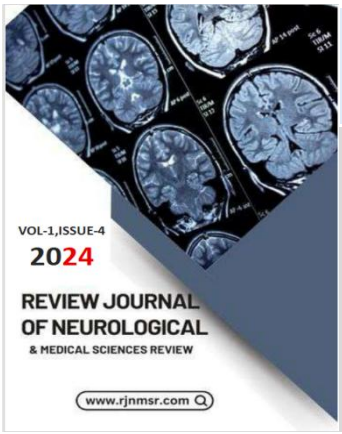
STUDY GAP

Previous studies have just discussed the clinical burden of malarial effects which are not justified because typically people are not immune. In this study Plasmodium falciparum and Plasmodium vivax are taken for accurate and efficient results.

LITERATURE

Globally, malarial infection is caused by bite of infected female Anopheles mosquito. (WHO, 2023).Malaria remains a significant public health concern (Khan, Anjum, Quresh, Fatima, & Khan, 2024). In the developing countries, more vulnerable people are particularly impacted by malaria than by any other public health issue (Karim , et al., 2021). As the World Health Organization reports data every year which is useful for the elimination and control of health disasters and diseases, World Health Organization also report malaria in 2022. In 2022, the WHO reported that about 249 million cases of malaria in all over the world, resulting in 608,000 deaths worldwide. This report is based on information collected from the 85 malarial-endemic counties that were associated with World Health Organization (WHO, 2023). People who are at high risk of severe illness of malaria are infants, children, pregnant women, older individuals and specially travelers (Memon, Syed, Tahir, Tahir, & huma, 2024). According to WHO, malaria is estimated to cause 10-15% of maternal mortality in malaria-endemic areas, although this percentage may vary according to local transmission rates and healthcare circumstances. (Obeagu EI & Obeagu GU, 2024)

All over the world, nurses take care of patients suffering from malaria. It is estimated that about 250 to 300 million cases of malaria are thought to occur globally each year, with anywhere from 1 to 2 million fatalities. Mortality rates are rising, in part because antimalarial medication resistance is growing. Two most prevalent species of plasmodium that cause malaria are Plasmodium vivax and Plasmodium falciparum. The most dangerous specie that can cause



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severe malaria that may leads to fatal is Plasmodium falciparum. (Thawornpan, Kochayoo, Salsabila, & Chootong, 2024) It may live in the human bloodstream for months or the entire life of the host asymptotically. Covell's review from 1960 supported the widely held belief that P. falciparum infections usually did not last more than a year, although nine cases were noted who's initial infection was reported. They came back after 1 to 2 years. He also cited Ciuca's analysis of 12,842 experimental cases of malaria from Romania that revealed a maximum persistence of Plasmodium falciparum infection of 27 months (Ashley & White, 2014). Plasmodium vivax uses the liver's hypnozoite reservoir as an additional means of survival in humans in addition to blood-stage parasite multiplication. A percentage of Plasmodium vivax sporozoites will mature into hypnozoites after being inoculated by an infecting mosquito. These sporozoites will then linger in the liver for weeks to years until they activate to generate new blood-stage infections. Relapses, which are blood-stage infections brought on by Plasmodium vivax hypnozoite activation, are a crucial characteristic that sets P.vivax and P.falciparum biology apart (White, Karl, Koepfli, Longley, Hofmann, & Wampfler, 2018).

In actuality, at different stages of parasite a number of P.vivax antigens have been tested, but very few vaccines have advanced to clinical testing. The absence of continuous culture technique for the blood stages has harmed the development of P.vivax vaccine, as well as the shortage of both fresh parasites from infected patients and appropriate experimental specimens to research parasite biology. Furthermore, the parasite P.vivax has genetic variety than P.falciparum. Vaccines have been formulated by focusing separately on three phases of life cycle of parasites (Thawornpan, Kochayoo, Salsabila, & Chootong, 2024). Malaria symptoms emerge during the malaria parasite's erythrocytic stage. The symptoms of Malaria are severe high temperature of body (fever) with chills, headache, muscle pain, cough, nausea and vomiting. At last stages, signs may include severe anemia, hypoxia, Splenomegaly, visual abnormalities, liver diseases, kidney disorders and cerebral malaria with neurological damage. (Deshmukh, Trivedi, & Balaji, , 2019). For the elimination of the malaria, primaquine has been the cornerstone of anti-relapse therapy for P.vivax but the ideal dosage is still unknown. Although point-of-care G6PD (glucose-6-phosphate dehydrogenase) testing is frequently unavailable in areas which are affected by malaria which is most national malaria programs advise low total doses of primaquine (3·5 mg/kg) given over 14 days to lower the risk of hemolysis, because side effect of severely use of medicine is hemolysis. (Commons, Rajasekhar, Edler, Abreha, Awab, & Baird, 2024)

Environmental factors such as climate, geography, urban and rural in Pakistan with extensive irrigation systems contribute to spread and persistence of infectious illnesses (Qureshi, Latif, & Muhammad, 2024). According to WHO; From January to August 2022 in Pakistan, 3.4 million patients contracted malaria. Almost170, 000 patients were reported which

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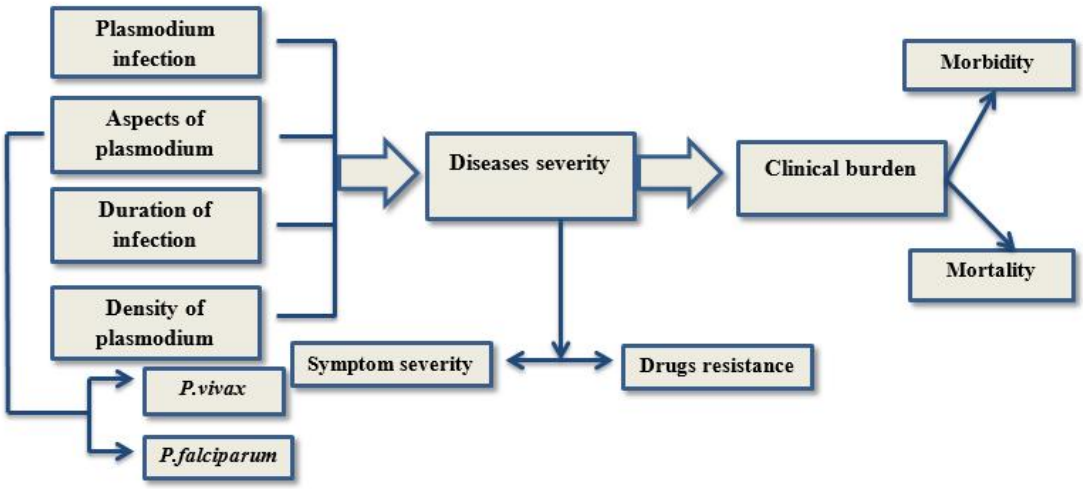
was confirmed from the government laboratories of Pakistan. Over 170,000 suspected malarial patients, 77% were caused due to the P.vivax and 23% were caused due to the P.falciparum, which is more dangerous for human health. (WHO, 2023). In Punjab almost 66.7% patient was contracted by P.vivax, 23.7% were contracted by P.falciparum and 9.6% were contracted by both plasmodium. During monsoon when rainfalls are at peak the severity of malaria is increases. (Qureshi, Latif, & Muhammad, 2024) .

A key role for the elimination of malaria is diagnosis of malaria, simply microscopy and RDTs by ICT may result in the false positive and false negative due to modification in parasite and low density infection. For the proper diagnosis of malaria, there must be use of proper sensitive and specific methods to get efficient results which leads to proper diagnosis. (Simmons, Sicuri, Carter, Hailu, & Kiemde, 2024). For the control of the burden of plasmodium infection is proper diagnosis and treatment of the malaria infection.

CONCEPTUAL FRAMEWORK

The conceptual framework explains the clinical burden of plasmodium infection. There are four independent variables which are plasmodium infection, types of plasmodium, density of plasmodium and duration of infection. There are three dependent variables which are clinical burden, morbidity and mortality of plasmodium infection. Diseases severity is the mediating variable which directly effects on dependent variable.

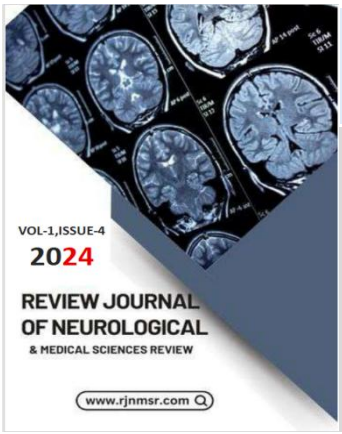


HYPOTHESIS

H1: Plasmodium has significant impact on clinical burden of plasmodium infection.

H2: P.vivax and P.falciparum has significant impact on clinical burden of plasmodium infection.

H3: Duration of infection has significant impact on clinical burden of plasmodium infection.



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H4: Density of plasmodium has significant impact on clinical burden of plasmodium infection.
H5: Diseases severity has significant impact on clinical burden of plasmodium infection.

RESEARCH METHODOLOGY

This study is followed by methods and procedures regarding data collection which are as follows:

RESEARCH DESIGN

This cross-sectional study was undertaken in the tropical region of South Punjab, District Muzaffargarh, Tehsil Kot Addu to examine clinical burden of plasmodium infection across local population of Kot Addu. This study was based on the primary and secondary data sources obtained from different direct (by taking sample of patient at different laboratories established by national malaria control program) and indirect methods (Articles, Website, and Reports).

TARGET POPULATION

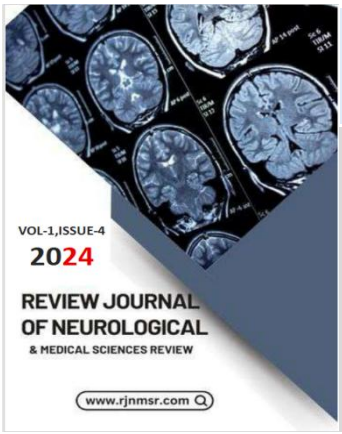
The population which is undertaken for the examination of clinical burden of plasmodium infection is the patients who are affected by plasmodium infection either from P.vivax or P.falciparum in the tropical region of South Punjab, District Muzaffargarh, and Tehsil Kot Addu which is specifically from Tehsil Headquarters (THQ) Hospital Kot Addu.

SAMPLE

To analyze data and research findings it is necessary to select the population which is undertaken for proper study according to criteria which is known as sample. For this research round about 384 respondents will surveyed to gather the necessary data. Morgen recommends a standard spreadsheet performance assessment to ensure reliable data evaluation. According to the Morgan's table (Krejcie & Morgan, 1970), 384 respondents are selected for the data collection. The sample is taken from region of South Punjab, District Muzaffargarh, and Tehsil Kot Addu in the Tehsil Headquarters (THQ) Hospital Kot Addu.

DATA COLLECTION

In the primary data collection, we discussed about the demographic factors including age, gender, climate, rural areas and 384 number of blood sample were collected by the healthcare workers by using venipuncture technique from July to October in 2023. A systematic questionnaire was used for the collection of primary data, which is based on all aspects of variable and are verified for clarity and its validity. Response recorded from each respondent for 3 months. While on the other hand, we discussed about secondary data, which was collected from the sentinel site which are THQ hospital laboratory and standardized laboratories established by National Malaria Control Program of district Muzaffargarh.



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DIAGNOSIS OF PLASMODIUM INFECTION

There are three valid methods for diagnosis of malarial infection caused by plasmodium parasites (P.vivax and P.falciparum) including: (1) by microscopic examination under the 100x lens (oil emersion lens) of blood, thick or thin smear slide prepared by Giemsa stain. (2) By using Rapid Diagnostic Tests (RDTs) based on immuno-chromatographic technique by using commercial kits of Malaria of P.vivax and P.falciparum Ab (abbot diagnostic). (3) The method of (PCR) Polymerase chain reaction but this method is not use in THQ Kot Addu.

DATA ANALYSIS

The major part of research is analysis of data. Data Analysis is the process of collection of data, transferring of data, and evaluation of data. The descriptive statistics assess analyzes data by various tables and figures in SPSS (Statistical Package for Social Sciences) software. Different statistical tools are used to analyses the accuracy and efficiency of data. Analyzes such as; regression, analysis of variance (ANOVA) and correlation.

RESULTS DISCUSSION

DIAGNOSIS AND CLINICAL BURDEN OF PLASMODIUM INFECTION

According to the DE morgen's table, 384 respondents were selected for the study of clinical burden of plasmodium infection to obtain the results. demographic factors were analyzed which are Age, Gender, Residence and occupation while the major variable was plasmodium infection which consist of types of plasmodium, density and severity of infection and there effects on prevalence which causes clinical burden as in the other regions of Pakistan For the diagnosis of plasmodium infection RDTs and microscopic technique were used to get more accuracy. By using RDTs (n=31) cases out of 384 were positive and 353 were negative cases while on the other hand, by using microscopic technique 34 cases were positive and 350 were negative cases . Almost 71% cases were affected by plasmodium vivax, (n=04) 12.9% cases were affected by plasmodium falciparum and (n=05)16.1% cases were affected by both plasmodium in the local population of the Kot Addu

PREVALENCE OF MALARIA ACCORDING TO SPECIE

Plasmodium vivax is the most prevalent specie that causing malaria among the local population of the kotaddu. Plasmodium infection due to the falciparum and mixed infection were observed as lowest causing malarial parasites, but the severity of the infection was high due to the mixed or falciparum. Almost 71% of the infection was caused due to the plasmodium vivax as in table 1. P.vivax infection was not only diagnosed in the patient of rural areas of the Kot Addu, it was also diagnosed in the patients of both urban and rural areas of tehsil Kot Addu. Primary data was collected by using Likert scale questionnaire method which was distributed among the public and private lab technicians and the secondary data was collected from the laboratory of the THQ hospital Kot Addu which indicates that the prevalence

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of the plasmodium vivax is greater than the plasmodium falciparum and mixed infection.

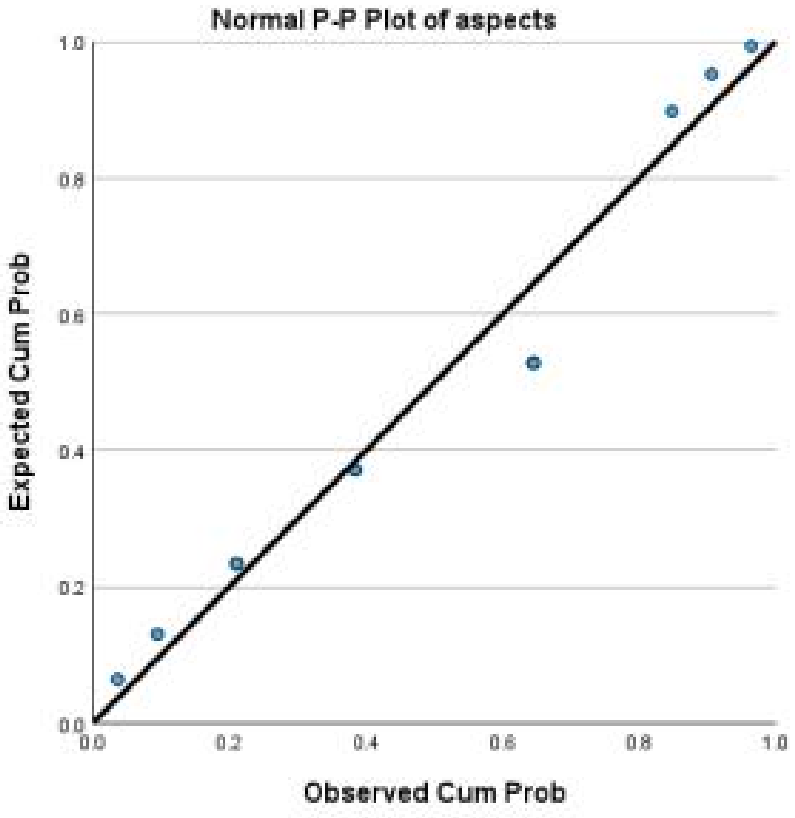
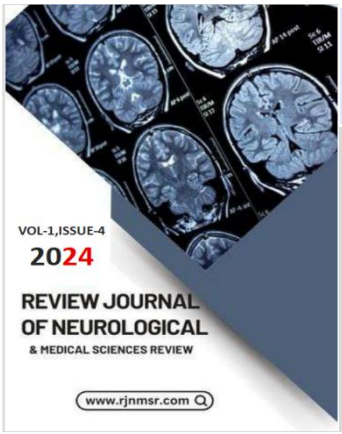


Table 1 Relationship of plasmodium infection according to specie

		Frequency	Percent	Valid %	Cumulative %
Valid	Vivax infection	22	71.0	71.0	71.0
	Falciparum infection	4	12.9	12.9	83.9
	Mixed infection	5	16.1	16.1	100.0
	Total	31	100.0	100.0	

PLASMODIUM INFECTION ACCORDING TO AGE

Plasmodium infection was diagnosed mostly in the age of 19-45 years in the rural and urban areas of Kot Addu. According to the de-morgen's table, 384 respondents were selected for the study of clinical burden of plasmodium infection. Diagnostic findings of plasmodium infection in the age of 06-18



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years having frequency n=2(5.9%) and age of 19-45 years having frequency 29(94.1%) as in Table 2.

TABLE 2 PLASMODIUM INFECTION ACCORDING TO AGE

		Frequency	Percent	Valid %	Cumulative %
Age Range	6-18	2	5.9	5.9	5.9
	19-45	29	94.1	94.1	100.0
	Total	31	100.0	100.0	

MONTH WISE CLINICAL BURDEN

Total 994 suspected cases were tested in the THQ Hospital Kot Addu 2023. In monsoon, the season of rainfall from July to October which is recorded as the highest malarial season 412 suspected cases were recorded out of which 31 were diagnosed by using RDTs. Peak month was diagnosed as July (04), august (11), September (09), October (07). Severity of the malaria was on peak during these months 384 respondents were taken understudy out of which the severe patients were neglected due to incomplete data. Mostly male patients were affected rather than the female.

REGRESSION

All variables, both independent and dependent, are displayed in reliability statistics. A review of reliability involves variables that are evaluated according to the degree of their mutual dependability. As in hypothesis, that Plasmodium, Duration of infection, Density of plasmodium has positive and significant impact on clinical burden of plasmodium infection. The results showed the significance of variables at 0.000 which prove to be the positive impact on dependent variable which explain Plasmodium has positive and significant relationship on clinical burden of plasmodium infection and with the density and severity of the plasmodium infection which indicates the morbidity and mortality rate that how plasmodium infection can increase clinical burden

TABLE 3 REGRESSION

Collinearity Diagnostics

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	density	Severity
1	1	2.941	1.000	.00	.00	.00

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2	.051	7.568	.00	.24	.35
3	.007	20.258	1.00	.76	.65

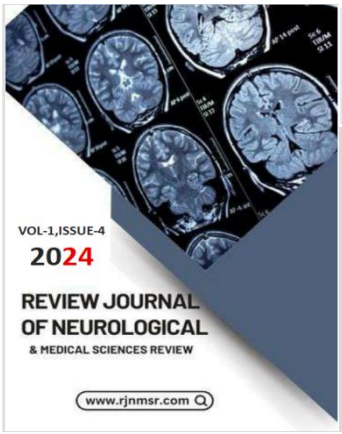
a. Dependent Variable: plasmodium

CORRELATION

The degree to which two variables are correlated with one another is explained with term of correlation. This test is applied to find and analyze the correlation that there is a substantial and positive correlation between the variables. Regardless of whether there are mediating variables between two variables, correlation quantifies their strength. The relationship between plasmodium infection and clinical burden is displayed in the table below, and it is significant at two-tailed correlations. The range of the correlation is -1 to +1. The most significant positive relationship is indicated by one above, and the most significant negative relationship is indicated by one below. Every other variable has a correlation of 1, and the plasmodium correlation in Table 2 is 1. The significance level at 1 in a horizontal series of results indicates that the study's findings are statistically significant. All of the variables values in this table have 0.000, indicating that the results are significant and positively correlated the correlation is significant at the 0.01 level. Social support, the mediating variable, has the strongest positive correlation and is significant at 0.000.

Table 4 CORRELATION

		Plasmodium	Aspects	Duration	Density	Severity
Plasmodium	Pearson Correlation	1	-.153	.197	-.591*	.377
	Sig. (2-Tailed)		.000	.000	.000	.000
	N	17	17	17	17	17
Aspects	Pearson Correlation	-.153	1	-.164	.044	-.325
	Sig. (2-Tailed)	.000		.000	.000	.000
	N	17	17	17	17	17
Duration	Pearson Correlation	.197	-.164	1	-.226	.766**
	Sig. (2-Tailed)	.000	.000		.000	<.000
	N	17	17	17	17	17
Density	Pearson	-.591*	.044	-.226	1	-.411



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	Correlation					
	Sig. (2-Tailed)	.000	.000	.000		.000
	N	17	17	17	17	17
Severity	Pearson Correlation	.377	-.325	.766**	-.411	1
	Sig. (2-Tailed)	.000	.000	.000	.000	
	N	17	17	17	17	17
*. Correlation Is Significant At The 0.05 Level (2-Tailed).						
**. Correlation Is Significant At The 0.01 Level (2-Tailed).						

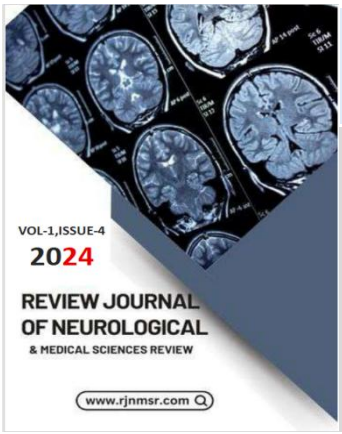
CONCLUSION

This study explains the prevalence of the plasmodium infection that the people of age group of 19-45 which were mostly affected with malaria because of less immunity. It was observed that the prevalence of the plasmodium infection is due to the improper disposal of the sewage water that play a constructive role in the growth of (female *Anopheles*) mosquito that causes malaria because most of the patients were contracted with plasmodium infection belongs to the rural areas of Kot Addu, especially areas like Ara Akbar shah and Daira din panna According to seasonal distribution, the month of monsoons (July–September) sees the highest number of malaria cases due to the by favorable environmental factors including high moisture and warmth. This study also explains that the type of plasmodium have also a positive impact on the clinical burden of plasmodium infection as it explained un result that Plasmodium vivax is the most prevalent specie that causing malaria while falciparum and mixed infection were observed as lowest causing malarial parasites, but the severity of the infection was high due to the mixed or falciparum.

LIMITATIONS AND RECOMMENDATIONS

There are some limitations which were caused in conducting this work. Major problem which was faced was lack of time. Due to time shortage this work was limited to malarial patients. The next could work on patients affected with dengue parasite. Secondly, the problem which was faced during the research was geographically segmentation of population which was limited to tehsil level the next could work on division wise to get more responses.

It is also recommended that there must be qualified staff at hospital to perform accurate tests which is major cause to diagnosis both plasmodium (vivax/falciparum).moreover, digital equipment may also fruitfully help in getting accurate results from laboratories to diagnose plasmodium infection in patients who are affected.



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