



ISSN: 2348-5906  
CODEN: IJMRK2  
IJMR 2016; 3(4): 50-52  
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Received: 09-05-2016  
Accepted: 10-06-2016

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## Influence of skin color in dengue and malaria: A case control study

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**Abstract**

Mosquitoes preferentially bite certain individuals by visual and olfactory cues. Dengue and Malaria, two of the most widespread mosquito borne diseases may be more common in people with certain skin tone due this fact. We compared the skin color (Fitzpatrick Scale) as a risk factor to be afflicted by dengue or malaria in 132 patients and 127 controls in a tertiary hospital in India. There was no significant difference in the skin tone between the patients with mosquito borne diseases ( $4.6 \pm 1.4$ ) and controls ( $4.7 \pm 1.3$ ),  $P=0.2$ . Our clinical study elucidates the role of skin color in dengue and malaria, pointing out the need for more experimental and clinical studies.

**Keywords:** Malaria, dengue, mosquito, skin tone

### 1. Introduction

Every year thousands of men, women and children are afflicted by mosquito borne diseases<sup>[1]</sup>. As mosquito niches increase due to global warming, even temperate countries are at risk to be attacked by these diseases<sup>[2]</sup>. Mosquito control is one of the vital strategies to prevent these diseases. The study of mosquito behaviour is an important subject of mosquito control research<sup>[3]</sup>. Mosquitoes are attracted to humans by many visual and olfactory cues. They tend to bite certain individuals more than others. This has partially been explained by the differences in the body odors amongst individuals<sup>[4]</sup>.

Mosquitoes are also known to be attracted to certain colours<sup>[5]</sup>. Particularly, mosquitoes prefer both black and brown in natural light<sup>[6]</sup>. Therefore, skin colour may be an important risk factor for infection with mosquito borne diseases like dengue and malaria. We compared the skin colour in patients with mosquito borne diseases and normal controls to find the difference.

### 2. Methods

#### 2.1. Subjects

For the study we calculated a sample size of 300 (including a 15% excess against loss of data.) subjects with 1:1 ratio of the cases: controls, to detect at least a mean difference in Fitzpatrick Skin Grading of 2 between the cases and controls. Patients of age 14 to 80 years diagnosed with malaria and/or dengue hospitalised in medical wards from August 2015 to December 2015 in the Govt. General Hospital, Guntur in South India were recruited by the study physicians. Patients with these two diseases were included as malaria and dengue are the most common mosquito borne diseases presenting to our hospital. To minimise the effect of confounding factors of socio economic nature the controls were recruited from patients hospitalised for other non mosquito borne diseases in the same wards. We compared the skin colour between the cases and controls. Patients were diagnosed with malaria by smear or rapid antigen test (antigen detection of *Plasmodium falciparum* and *Plasmodium malariae* by ADVANTAGE MALARIA CARD, J.Mitra& Co, India) and dengue by rapid test (Dengue NS1 antigen and IgM by Dengue Day 1 Test, J.Mitra& Co, India). The skin colour of the patients was graded from 1-6 using the Fitzpatrick skin colour template of the patients' dorsum of the hand at bedside. Written informed consent was obtained from the patients. The study was approved by the Institutional Ethical Committee at Guntur Medical College, Guntur. STROBE guidelines for case control study were followed. The study is a cross sectional, observational unmatched case control study.

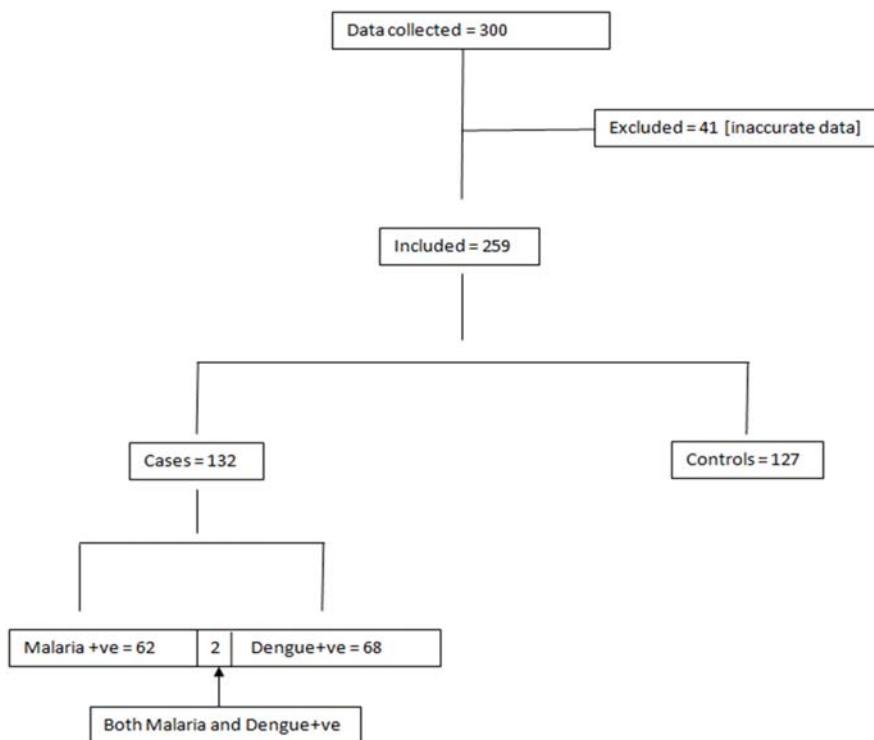
**2.2 Statistics**

The data was tabulated in MS Excel 2010 and analysis was done on IBM SPSS ver. 21. Statistical analysis was done by the study physician. The mean Fitzpatrick skin colour grade (FSG) was calculated and compared between groups by t- test for independent samples. Percentages and odd's ratios were calculated. All missing data was excluded from analysis. Quantitative data was described by mean and standard deviation and analysed by student independent t test.

Qualitative data was described by percentage and analysed by chi-square test. Statistical significance was considered relevant with two sided  $P < 0.05$ .

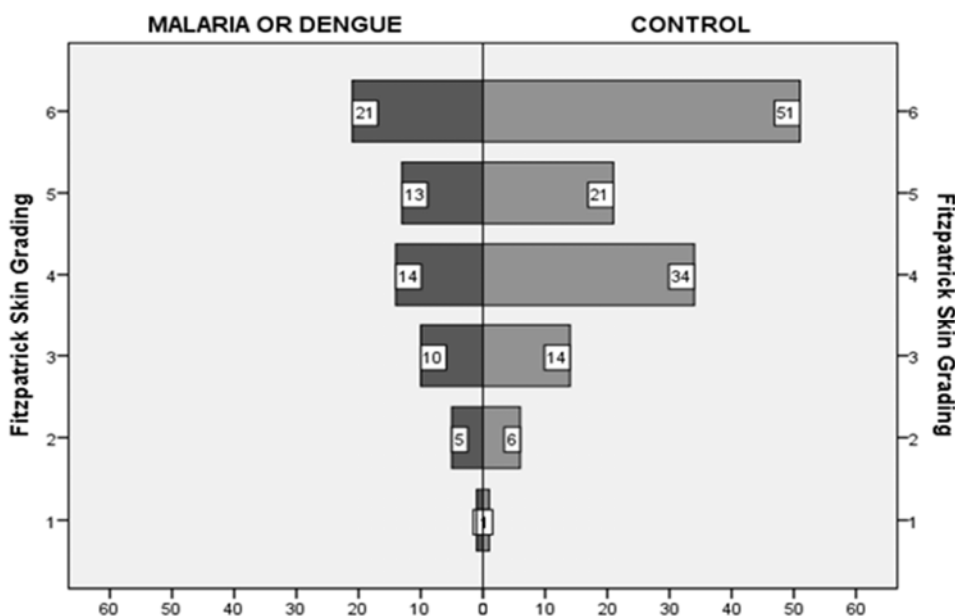
**3. Results and Discussion**

After data scrutiny 133 cases and 130 controls were included for analysis (Fig 1).



**Fig 1:** Recruitment and study diagram

Most of the subjects were found under Fitzpatrick Scale 6 (Fig 2).



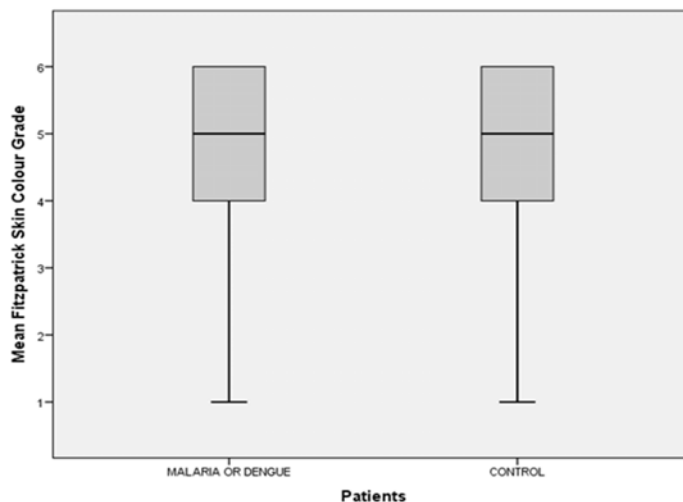
**Fig 2:** Skin Colour in Cases and Controls

Most of our patients with malaria or dengue were from urban regions (Table 1).

**Table 1:** Clinico demographic details of the subjects.

| Characteristic            | Mosquito borne disease patients | Control patients | P value for statistically significant difference |
|---------------------------|---------------------------------|------------------|--|
| Mean Age(SD)              | 35.5(15.2)                      | 38.9(14.0)       | 0.05   |
| Women%                    | 42.1%(56/132)                   | 36.9%(48/127)    | 0.39   |
| Rural residence%          | 28%(37/132)                     | 49.2%(59/120)    | 0.001  |
| Manual outdoor occupation | 63.2%(84/132)                   | 68.6%(83/127)    | 0.16   |

There was no significant difference in the FSG between the patients with mosquito borne diseases ( $4.6 \pm 1.4$ ) and controls ( $4.7 \pm 1.3$ ),  $P=0.2$ (Fig 3).



**Fig 3:** Comparison of skin color grading between patients and controls

Sub group analysis of patients showed that there was no significant difference in the FSG between the patients with malaria ( $4.5 \pm 1.4$ ), patients with dengue ( $4.6 \pm 1.4$ ) and controls ( $4.7 \pm 1.3$ ),  $P=0.4$ .

Fitzpatrick skin colour was similar ( $4.6 \pm 1.4$ ) vs. ( $4.7 \pm 1.3$ ) in mosquito borne disease patients and controls. Our study comparing the skin colour of 132 patients with 127 controls as a risk for mosquito borne disease, showed no particular association. This equivocal result probably represents the multifactorial risks for a mosquito bite and the consequent development of clinical disease.

Clinical studies studying the affect of human skin color on mosquito borne diseases are limited. Experimental studies have shown that mosquitoes actually have colour preferences. This is pronounced when aided by odor cues [5]. Our study does not consider this variable. Other variables such as the surrounding chemical cues, the humidity and wind speeds in the area also affect the attraction of the mosquito to the host [7]. The various measures taken by the people to protect themselves from mosquito bites may also influence the results. These were also not considered in our analysis. All these factors may have affected the results significantly.

There are certain limitations to our study. Hospital based data may not reflect the true picture of human interaction with mosquitoes. The design of the study could not capture previous episodes of mosquito borne diseases in the subjects, which also was a confounding factor. As most of the subjects were of 4-6 FSG, the results may be affected.

Even as the study shows that skin colour may not be an important risk factor for mosquito borne diseases, further experimental and clinical studies are needed to understand the issue.

#### 4. Acknowledgements

We thank Dr Rama Krishna for support and encouragement.

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