

Behavioural Disturbances Related with Febrile Illnesses: A Hospital-based Longitudinal Study

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ABSTRACT

Introduction: Various psychiatric symptoms are seen in patients with fever and during the course of treatment of fever. Due to meager understanding and limited knowledge along with poor infrastructure and lack of facility in peripheral healthcare centres, many patients of febrile psychosis are referred to tertiary centres.

Aim: To study the demographic, clinical profile and diagnostic categorisation of various behavioural manifestations in febrile patients.

Materials and Methods: The present hospital-based longitudinal study was conducted at Department of Psychiatry, Shyam Shah Medical College, Rewa, Madhya Pradesh, India, from January 2021 to August 2021, on 54 patients, who developed psychiatric symptoms during course or after remission of fever. Detailed socio-demographic characteristics, clinical profile, along with psychiatric assessment, were recorded in proforma designed for the study. Data was analysed using Statistical Package for the Social Sciences (SPSS) software version 26.0 (IBM Corp. Armonk, NY, USA).

Results: Out of total 54 patients, in the age group of 21 to 30 years, there were 18 (33.3%) patients and in 31 to 40 years, there were 12 (22.2%) patients who developed psychiatric symptoms after remission or during the course of fever. Most of the patients 40 (74.1%) were hailed from rural areas, 26 (48.1%) patients belonged to lower-middle socio-economic status, majority of the subjects (19, 35.2%) were shop owners, clerks and farmers. Overall, 19 (35.1%) patients developed psychosis due to malarial fever followed by enteric fever (13, 24.1%), viral fever (9, 16.7%), tuberculosis (3, 5.6%) and rheumatic fever (1, 1.8%). Drug-induced behavioural disturbance was found in 9 (16.7%) patients.

Conclusion: General conception among peripheral healthcare workers is that behavioural abnormalities associated with fever occur solely due to serious illnesses like meningitis, encephalitis and cerebral malaria, but present study suggests that a fair number of these psychiatric manifestations are either induced or precipitated functional psychosis and resolve on appropriate management.

INTRODUCTION

Many patients develop behavioural disturbances pertaining to temporal region in relation to fever due to metabolic or other systemic disturbances in the body owing to underlying cause [1-3]. Moreover, fever itself can act as a precipitating factor or unmask latent psychiatric disorders in otherwise normal individuals [4]. Many times these cases present as diagnostic dilemma i.e., whether the present state is due to cerebral assault owing to fever, or is a separate psychiatric illness superimposed on fever. At times the drugs used in management of febrile illness can also produce psychiatric symptoms, further complicating the clinical picture [5-9].

Due to meager knowledge among healthcare workers regarding these issues, along with misperception that it is life threatening state of fever by majority of the patients and their attendants, these patients are referred to higher centers for further management. Febrile psychosis has variable course but in most of cases they are completely reversible with timely recognition and appropriate intervention [10]. More over in general practice, various infectious causes are easily recognised but unfortunately no well-designed Indian study is available pertaining to such clinical problems as a result, psychiatric causes often remain unidentified. Hence, the present study was done to gain insight regarding diagnostic categorisation and clinical profile of such patients so that appropriate treatment can be instituted in time.

MATERIALS AND METHODS

This hospital-based longitudinal study was conducted at Department of Psychiatry, Shyam Shah Medical College, Rewa, Madhya Pradesh, India, from January 2021 to August 2021. The Helsinki declaration was respected and the patient anonymity was also

Keywords: Behavioural manifestations, Febrile psychosis, Fever

maintained. The data were recorded keeping the patient names obscure.

Inclusion criteria: Patients of age 15 years and above and both genders were included. During these six months, all febrile psychotic patients presenting to the facility from peripheral health centres were assessed for eligibility and the patients who met the study criteria were included in the study.

Exclusion criteria: Patients with acute medical, surgical or psychiatric emergency, patients with substance use history, history of psychiatric illness just preceding fever were excluded from the study.

All patients were hospitalised. Detailed history, physical and neuropsychiatric examination and relevant investigations were carried out to establish the aetiology of febrile and neuropsychiatric illness. Out of 74 patients, 20 were excluded for various reasons and rest 54 subjects formed the study sample.

Diagnosis of behavioural disturbances is based on International Classification of Diseases (ICD)-10 Classification of Mental and Behavioural Disorders: Diagnostic Criteria for Research [11]. Treatment for medical illness was started immediately after admission on the basis of provisional diagnosis. For agitation, symptomatic treatment with sedatives, tranquilisers like diazepam, lorazepam were given, as and when required during observation phase. To determine the socio-economic status of the participants, modified Kuppuswamy socio-economic scale 2020 [12].

STATISTICAL ANALYSIS

Data were collected with the help of semi-structured proforma consisting of various socio-demographic and clinical variables. Statistical data were measured in terms of number and frequency

using SPSS software version 26.0 (IBM SPSS Statistics for Windows, IBM Corp. Armonk, NY, USA).

RESULTS

Total 54 diagnosed cases of fever with behaviour disturbances were enrolled into the study. Patient's socio-demographic variables were studied [Table/Fig-1]. Majority of the patients (18, 33.3%) were in the age range of 21 to 30 years, and females (30, 55.6%) outnumbered the males (24, 44.4%). Most of patients (40, 74.1%) were residents

Variables	N (%)
Age (years)	
15 to 20	9 (16.7%)
21 to 30	18 (33.3%)
31 to 40	12 (22.2%)
41 to 50	10 (18.5%)
51 to 60	2 (3.7%)
≥61	3 (5.6%)
Gender	
Male	24 (44.4%)
Female	30 (55.6%)
Marital status	
Single	12 (22.2%)
Married	42 (77.8%)
Socio-economic status (Modified Kuppuswamy socio-economic scale 2020)	
Upper	0
Upper-middle	3 (5.6%)
Lower-middle	26 (48.1%)
Upper-lower	21 (38.9%)
Lower	4 (7.4%)
Domicile	
Rural	40 (74.1%)
Urban	14 (25.9%)
Occupation	
Unemployed	10 (18.5%)
Skilled worker	8 (14.8%)
Unskilled worker	17 (31.5%)
Shop owner/Clerical job/Farmer	19 (35.2%)
Professional	0
Family history of psychiatric illness	
Present	10 (18.5%)
Absent	44 (81.5%)

[Table/Fig-1]: Socio-demographic variables.

N: Number of patients=54

of rural areas. About 26 (48.1%) patients belonged to lower-middle socio-economic status, followed by upper-lower (21, 38.9%). Majority of subjects (19, 35.2%) were from farmer/clerical/shop owner group followed by unskilled workers (17, 31.5%), while most of the patients were married (42, 77.8%).

Maximum patients (51, 94.4%) presented by six days of onset of psychiatric symptoms. Only 3 (5.5%) patients presented by seven to eight days of onset of psychiatric manifestations. In comparison, the duration of fever was variable with maximum patients came on three to four days (13, 24.1%). Only one patient presented within 11 to 12 days of fever [Table/Fig-2].

[Table/Fig-3], maximum subjects had behavioural disturbances after malarial fever (19, 35.1%) followed by enteric fever (13, 24.1%). Acute polymorphic psychotic disorder without symptoms of schizophrenia (14, 26%) was the most common diagnosis. Patient with functional psychosis (24, 44.5%) were higher than organic psychosis (21, 38.8%) [Table/Fig-4].

DISCUSSION

Emergence of behavioural manifestation with fever is invariably considered an ominous sign and the terminal state of fever by majority of the patients and their attendants. Owing to various grave diseases like meningitis, encephalitis and cerebral malaria in our subcontinent, abnormal behaviour developing in temporal correlation with fever draws attention of physician also. In general practice, various infectious causes are easily recognised but unfortunately no well-defined Indian study is available pertaining to such clinical problems and only stray reports are available in western literature. As a result, psychiatric causes often remain obscured, unidentified or ignored due to lack of conceptualisation. Various causative factors are responsible for abnormal behavioural manifestations following fever. This would enable us to adopt an integrated approach towards diagnosis, management and would provide scientific formulations to deal such cases.

The present study was envisaged in the hospitalised febrile patients. Identification of psychiatric manifestations after fever was the major objective. Incidences of both major and minor psychiatric comorbidities were found higher in febrile patients as compared to magnitude in general population in earlier studies. Venkatesh S and Grell GA found neuropsychiatric manifestations of typhoid fever in 18 out of 40 consecutive patients [13]. Hafiez HB reported incidence of psychotic disorder with typhoid fever to be 8% in study of 602 patients [2]. Nevin RL and Croft AM also found that malaria and antimalarial drugs have higher numbers of psychiatric manifestations [14].

Majority of the patients in the present study belonged to the age group of 21-30 years (18, 33.3%) [Table/Fig-1]. The present study therefore supports the notion that behavioural disturbances mainly

Variables	Duration of fever at the time of presentation										
	Days	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	>16	Total
Duration of psychiatric manifestation	1-2	2	-	-	-	1	-	1	2	-	6
	3-4	-	13	7	4	3	-	-	1	1	29
	5-6	-	-	4	7	2	1	-	1	1	16
	7-8	-	-	-	-	-	-	1	2	-	3
	9-10	-	-	-	-	-	-	-	-	-	-
	Total	2	13	11	11	6	1	2	6	2	54

[Table/Fig-2]: Duration of psychiatric illness in relation to duration of fever.

Febrile patient groups with psychiatric manifestations	N (%)
Enteric fever	13 (24.1%)
Viral fever	9 (16.7%)
Malaria fever	19 (35.1%)
Tuberculosis	3 (5.6%)

Drug-induced behavioural disturbance	9 (16.7%)
Rheumatic fever	1 (1.8%)
Total	54 (100%)

[Table/Fig-3]: Percentage of variable febrile illness presented as behavioural disturbances.

Diseases	Psychiatric diagnosis according to ICD-10										Total (N)
	Organic mental disorders				Functional mental disorders					Drug-induced	
	F05	F06.1	F06.2	F07.1	F23.0	F23.1	F23.2	F23.8	F31	F1X.53	
Malaria fever	3	-	1	-	9	-	3	3	-	-	19
Enteric fever	2	3	2	-	3	2	-	-	1	-	13
Viral fever	6	-	-	2	-	-	-	-	1	-	9
Tuberculosis	1	-	-	-	2	-	-	-	-	-	3
Rheumatic fever	-	-	1	-	-	-	-	-	-	-	1
Drug-induced behavioural disturbance	-	-	-	-	-	-	-	-	-	9	9
Total	12 (22.2%)	3 (5.5%)	4 (7.4%)	2 (3.7%)	14 (26%)	2 (3.7%)	3 (5.5%)	3 (5.6%)	2 (3.7%)	9 (16.7%)	54 (100%)

[Table/Fig-4]: Psychiatric diagnosis in various febrile illnesses.

F05=delirium, not induced by alcohol and other psychoactive substances; F06.1=organic catatonic disorder; F06.2=organic delusional (schizophrenia-like) disorder.

F07.1=post encephalic syndrome; F23.0=acute polymorphic psychotic disorder without symptoms of schizophrenia; F23.1=acute polymorphic psychotic disorder with symptoms of schizophrenia

F23.2=acute schizophrenia like psychotic disorder; F23.8=other acute and psychotic disorder; F31=bipolar affective disorder; F1X.53=drug-induced psychotic disorder predominantly polymorphic type

Above coding is based on ICD-10 Classification of Mental and Behavioural Disorders: Diagnostic Criteria for Research [11]

afflict adult age group (42, 77.7%) and less on geriatric group (3, 5.6%). A study conducted by Collins PY et al., had more younger cases (<35 years) developing acute brief psychosis precipitated by fever [15]. Since there were less number of patients in the older age group it appears that degenerative and vascular changes did not seem to play pivotal role in the current series of the febrile psychotic manifestations. Even healthy subjects of young and middle age groups may develop abnormal behaviour with fever.

There was preponderance of female patients in study population [Table/Fig-1]. Poor nutritional status, anaemia, interfamilial stress etc., among females could be cause for such variation. The majority of subjects belonged to lower-middle socio-economic status followed by upper-lower class, which simply seems to be due to the socio-economic structure of the community in this Vindhya region of Madhya Pradesh, India. However, a possibility remains that subjects with higher socio-economic status have better mental, physical and social health and therefore, are less prone to severe infectious diseases and to psychotic manifestations. The majority of the patients (40, 74.1%) hailed from rural areas (due to rural dominance in this subcontinent). The majority of patients (19, 35.2%) were shop owners, clerks and farmers followed by unskilled workers (17, 31.5%) and unemployed (10, 18.5%). Gautham MS et al., also found that lower socio-economic persons are having more behavioural problems [16]. Genetic loading was observed in only 18.5% and seems to be an important vulnerability factor which could be a predisposing factor. In a study conducted by Marsman A et al., (2018), familial factors explained around 4% of the variance in mental health [17].

Bulk of the subjects consulted higher centers (like the study institute) within a period of six days (51, 94.4%) once the psychiatric symptoms emerged. Nair RK et al., and Mudiyansele MHH et al., also found cases of fever with abnormal behaviour reaching hospitals within six to seven days of presentation [10,18]. The observations suggest that abnormal behaviour in conjunction with fever becomes most alarming symptom and compelled them to seek higher centers. Being an important cause of referral from the periphery, large number of these patients were either provisionally diagnosed as encephalitis, meningitis or cerebral malaria. It reflects the inadequacy and limited awareness to deal such cases. Only few cases (3, 5.5%) considered hospitalisation late by the end of seven to eight days. Greater distance from the higher centers or indulgence into religious rituals and faith healing practices may be reason for delayed psychiatric consultations.

The functional psychiatric patients (24, 44.5%) were higher as compared to organic psychosis (21, 38.8%) excluding drug-induced psychosis, which were also reasonably higher (9, 16.7%). Biswas PS et al., and, Nevin RL and Croft AM stated that many classes of drug including the quinoline derivatives are known to cause psychiatric effects [5,14].

The pattern of fever correlated fairly well with underlying causes, although classical pattern of fever was infrequently observed with malaria and enteric fever. This can be due to early administrations of antibiotic/antimalarial and frequent use of antipyretics [14,19]. Malaria (19, 35.1%) was single largest cause producing psychosis, chiefly (9, 47.3%) in the form of acute polymorphic psychosis with or without schizophrenic symptoms. David D et al., found that nine out of the 17 patients of malaria with psychosis presented with clear consciousness [20]. Thus, not all conditions presenting with psychiatric manifestations and malarial fever are due to cerebral malaria. Enteric fever (13, 24.1%) was second common cause of psychosis. Enteric fever can produce both organic as well as functional psychosis, also it can precipitate primary functional psychosis among vulnerable subjects [10,21]. Organic psychosis due to enteric fever was chiefly informed of infective psychosis (2, 15.3%) and organic catatonia (3, 23.07%) whereas, functional psychosis was predominantly acute polymorphic type with or without symptoms of schizophrenia (5, 38.5%). Talukdar P et al., have also found catatonia in typhoid fever [21]. Enteric fever precipitated bipolar affective disorder mania in (1, 7.6%) patient with heavy genetic loading. Santangelo CG et al., also reported mania after typhoid fever [22]. Thus, proper medical and family history, assessment of premorbid personality traits, detailed mental status examination are necessary to differentiate between above conditions as therapeutic approach and outcome is different for each.

Viral fever produced behavioural disturbances in 9 (16.7%) patients. Behavioural disturbances due to viral fever were also reported by earlier investigators Boyapati R et al., and Chaudhury S et al., [3,23]. Infective psychosis (6, 66.6%) and postencephalitic syndrome (2, 22.2%) were result of acute viral encephalitis involving Central Nervous System (CNS) as whole or sometimes in a localised form chiefly at limbic circuit. Chandra SR et al., and Noppeney U et al., also found that when viral fever predominantly affecting limbic system or temporal lobe then psychiatric manifestations may occur [24,25]. Thus, whenever the clinical picture is suggestive of viral fever or if disease do not show expected response to treatment with antibiotic/antimalarials the possibility of viral infection must also be entertained.

Tuberculosis in 3 (5.6%) patients produced an infective type of psychosis in one subject whereas acute polymorphic psychosis in others. Mason PH et al., also reported psychosis in tuberculosis [26]. These conditions need differentiation from miliary tuberculosis, tuberculoma in CNS and anoxic encephalopathy due to lung fibrosis. Three drugs chloroquine, ciprofloxacin and isonicotinic acid hydrazide used commonly in treatment of malaria, enteric fever and tuberculosis respectively were found to induce psychosis [14,27,28]. Therefore, the possibility of a drug-induced psychosis should always be ruled out in above conditions presenting with psychosis with prior treatment history as in such cases prompt stoppage of drug is necessary. Such conditions do not resolve on stoppage of drug

as active psychiatric intervention with psychotropics and occasional electroconvulsive therapy was necessary in majority of such cases.

Rheumatic fever (1, 1.8%) produced an organic delusional disorder in a young patient. Teixeira AL et al., also reported psychosis in rheumatic fever [29]. It can be an uncommon cause of psychosis especially in young children and adolescents.

Not all febrile conditions presenting with behavioural abnormality are due to serious illness like meningitis, encephalitis and cerebral malaria. A fair number of these disorders are psychiatric manifestations of either induced or precipitated functional psychosis and will resolve on appropriate management.

Limitation(s)

Sample size was small. Results of the present study cannot be generalised as the study population was from particular geographical area. Lack of previous well organised studies on this topic provides limited support to these findings.

CONCLUSION(S)

It can be concluded that not all febrile psychosis are due to organic general medical causes. In addition to organic febrile psychosis, functional disorders are also significant causes of abnormal behaviour in relation to febrile psychosis. Hence, concerted efforts are necessary towards training of practicing physician's especially working at peripheral centers and a holistic approach covering both physical as well as psychiatric aspects are our recommendations, so that early recognition and appropriate treatment can be instituted.

REFERENCES

- [1] Román GC, Senanayake N. Neurological manifestations of malaria. *Arq Neuropsiquiatr.* 1992;50(1):03-09.
- [2] Hafeiz HB. Psychiatric manifestations of enteric fever. *Acta Psychiatr Scand.* 1987;75(1):69-73.
- [3] Boyapati R, Papadopoulos G, Olver J, Geluk M, Johnson PDR. An unusual presentation of herpes simplex virus encephalitis. *Case Rep Med.* 2012;2012:e241710.
- [4] Mrozek S, Vardon F, Geeraerts T. Brain temperature: Physiology and pathophysiology after brain injury. *Anesthesiol Res Pract.* 2012;2012:e989487.
- [5] Biswas PS, Sen D, Majumdar R. Psychosis following chloroquine ingestion: A 10-year comparative study from a malaria-hyperendemic district of India. *Gen Hosp Psychiatry.* 2014;36(2):181-86.
- [6] Mulhall JP, Bergmann LS. Ciprofloxacin-induced acute psychosis. *Urology.* 1995;46(1):102-03.

- [7] Gupta A, Chadda RK. Adverse psychiatric effects of non-psychotropic medications. *BJPsych Adv.* 2016;22(5):325-34.
- [8] McCue JD, Zandt JR. Acute psychoses associated with the use of ciprofloxacin and trimethoprim-sulfamethoxazole. *Am J Med.* 1991;90(4):528-29.
- [9] Bhatia MS, Malik SC. Psychiatric complications of chloroquine. *Indian J Psychiatry.* 1994;36(2):85-87.
- [10] Nair R, Mehta S, Kumaravelu S. Typhoid fever presenting as acute psychosis. *Med J Armed Forces India.* 2003;59(3):252-53.
- [11] World Health Organisation. ICD-10: International statistical classification of diseases and related health problems: tenth revision [Internet]. World Health Organisation; 2004 [cited 2021 Dec 1]. Available from: <https://apps.who.int/iris/handle/10665/42980>.
- [12] Saleem S. Modified Kuppuswamy socioeconomic scale updated for the year 2020. 2020 Apr 22;
- [13] Venkatesh S, Grell GA. Neuropsychiatric manifestations of typhoid fever. *West Indian Med J.* 1989;38(3):137-41.
- [14] Nevin RL, Croft AM. Psychiatric effects of malaria and anti-malarial drugs: Historical and modern perspectives. *Malar J.* 2016;15(1):332.
- [15] Collins PY, Varma VK, Wig NN, Mojtabal R, Day R, Susser E. Fever and acute brief psychosis in urban and rural settings in north India. *Br J Psychiatry.* 1999;174(6):520-24.
- [16] Gautham MS, Gururaj G, Varghese M, Benegal V, Rao GN, Kokane A, et al. The National Mental Health Survey of India (2016): Prevalence, socio-demographic correlates and treatment gap of mental morbidity. *Int J Soc Psychiatry.* 2020;66(4):361-72.
- [17] Marsman A, Pries LK, ten Have M, de Graaf R, van Dorsselaer S, Bak M, et al. Do current measures of polygenic risk for mental disorders contribute to population variance in mental health? *Schizophr Bull.* 2020;46(6):1353-62.
- [18] Mudiyansele MHH, Weerasinghe NP, Pathirana K, Dias H. Misdiagnosis of cerebral malaria initially as acute psychotic disorder and later as human rabies: A case report. *BMC Res Notes.* 2016;9:400.
- [19] Aneja J, Goya D, Choudhary B. Psychosis consequent to antimalarial drug use in a young child. *J Fam Med Prim Care.* 2019;8(5):1781-83.
- [20] David D, Fleminger S, Kopelman M, Lovestone S, Mellers J. *Lishman's Organic Psychiatry: A Textbook of Neuropsychiatry.* John Wiley & Sons; 2012. Pp. 961.
- [21] Talukdar P, Dutta A, Rana S, Talukdar A. Catatonia and parkinsonism as a sequelae of typhoid fever: A rare experience. *BMJ Case Rep.* 2013;2013:bcr2013010220.
- [22] Santangelo CG, Goldstein D, Green S. A case of bipolar disorder and typhoid fever. *Int J Psychiatry Med.* 2004;34(3):267-69.
- [23] Chaudhury S, Jagtap B, Ghosh DK. Psychosis in dengue fever. *Med J Dr Patil Univ.* 2017;10(2):202.
- [24] Chandra SR, Seshadri R, Chikabasaviah Y, Issac TG. Progressive limbic encephalopathy: Problems and prospects. *Ann Indian Acad Neurol.* 2014;17(2):166.
- [25] Noppeney U, Patterson K, Tyler LK, Moss H, Stamatakis EA, Bright P, et al. Temporal lobe lesions and semantic impairment: A comparison of herpes simplex virus encephalitis and semantic dementia. *Brain.* 2007;130(4):1138-47.
- [26] Mason PH, Sweetland AC, Fox GJ, Halovic S, Nguyen TA, Marks GB. Tuberculosis and mental health in the Asia-Pacific. *Australas Psychiatry Bull R Aust N Z Coll Psychiatr.* 2016;24(6):553-55.
- [27] Rossi G, Mazoki K. Acute psychosis after treatment of epididymitis with ciprofloxacin. *Cureus.* 2018;10(5):e2605.
- [28] Prasad R, Garg R, Verma SK. Isoniazid- and ethambutol-induced psychosis. *Ann Thorac Med.* 2008;3(4):149-51.
- [29] Teixeira AL, Maia DP, Cardoso F. Psychosis following acute Sydenham's chorea. *Eur Child Adolesc Psychiatry.* 2007;16(1):67-69.

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