A Bio-Psychosocial Framework for Chronic Daily Headaches: A Mixed Methods Study

Bhuvaneshwari Balasubramanian¹, Vasundharaa. S. Nair¹, Nimmy George², Ashok V. Reddy², Priya Treesa Thomas¹, and Girish B. Kulkarni²

Abstract
Chronic daily headaches (CDH) are primarily understood from a psychophysiological formulation. A broad biopsychosocial understanding, where there is equal importance given to biological, psychological and socio-cultural factors, is underexplored in headache. Socio-cultural factors, such as gender, socio-economic factors can perpetuate and worsen the condition. For an effective and sustainable intervention, these factors need to be considered. The current study aims to explore and develop a biopsychosocial framework for headache disorders. A convergent parallel mixed methods design was used and participants were recruited from a tertiary referral care hospital, Bengaluru, India. Headache Assessment Sheet, GAD 7, HDRS, PSS and BCOPE were used in the quantitative phase. The data was analysed using r software. Qualitative phase of the study, in depth interview guide was used and data analysed thematically. Quantitative phase, 38 participants were recruited. The average age, was 38.02 (±10.17), majority of the participants being females 31 (81.58%). The mean duration of illness was 8.63 (±4.73) years. The anxiety scores positively correlated with pain intensity (r = 0.50 at P ≤ .001) and the median anxiety scores varied with photophobia (P ≤ .03). The anxiety scores correlated with PSS (r = 0.428 at P ≤ .007) and HDRS (r = 0.428 at P ≤ .007) scores. Gender variations in coping were seen, avoidant coping having higher median scores in women. (P ≤ .08). In qualitative phase of the study, six participants were recruited. Three main themes emerged from the qualitative phase of the study: headache - an illness, headache factors and the impact. Chronic daily headaches are influenced by biological, psychological, environmental and socio-cultural factors. A bio-psychosocial framework will help to understand and develop targeted interventions.

Keywords
chronic daily headaches, bio-psychosocial framework, stress, interventions, mixed methods study

Introduction
Chronic Daily Headache (CDH), headache that affects an individual for 15 days a month for three months or more (1), has the global prevalence of 3% (2), and 2.1% in India (3). A systematic review of the prevalence of chronic pain conditions in low and middle-income countries also places the prevalence of chronic daily headaches at 5% (4). There is an increasing recognition of the impact of headache worldwide, and headache is recognised as the third most frequent cause of disability worldwide and migraine alone is sixth (5).

Most persons with CDH initially suffer from episodic headache which later transforms due to several risk factors. Risk factors for transformation could be modifiable (eg: psychiatric problems, sleep-related problems, obesity, etc) or non-modifiable (eg: gender, age, socio-economic status, major life events, etc) (6).

From a biomedical understanding of headache disorders, it is conceptualised as a chronic condition that is characterised by acute episodes of pain lasting from a few minutes to days. A more psychophysiological formulation that has evolved in recent years has formed the basis for a number of behavioural treatments for headache disorders (7). Psychophysiological formulation looks at the psychological

1 Department of Psychiatric Social Work, National Institute of Mental Health and Neuro Sciences (NIMHANS), Bengaluru, Karnataka, India
2 Department of Neurology, National Institute of Mental Health and Neuro Sciences (NIMHANS), Bengaluru, Karnataka, India

Corresponding Author:
Priya Treesa Thomas, Associate Professor, Department of Psychiatric Social Work, National Institute of Mental Health and Neuro Sciences (NIMHANS), Bengaluru, Karnataka, India.
Email: priyathomasat@gmail.com

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and environmental stressors and its influence on the headache, directly leading to recommendations for psychopharmacological management. The importance of social factors that influence the headache disorders are under explored. In 1970, Engel first proposed the bio-psychosocial model for illness especially chronic diseases stressing the need to move away from a purely bio-medical model of illness. Even after 40 years of positive research and application of this model the complete utilisation of the same in many chronic conditions is wanting (8). Adopting this broader biopsychosocial model for headache disorders has been increasingly found useful in recent decades. (9,10). The current study aims to explore and develop a biopsychosocial framework for headache disorders, taking into account the sociocultural context.

Methods

Mixed methods research is popularly used in health care research especially in chronic pain conditions to utilise the strengths of both methods. To maintain the rigour in the mixed methods study, O’ Cathain’s 4 criteria of reporting have been followed (11). The study employed a convergent or parallel design, where the qualitative and quantitative data are given equal importance. The data was collected simultaneously, analysed separately and then integrated at the stage of interpretation of the findings. The integration was done to check the complementarity of data and develop a biopsychosocial framework for headache disorders (12). The interpretative rigour as discussed by Tashakkori has been followed to maintain the methodological rigour in the study. (13)

Participants and Setting

Patients, both male and female, seeking treatment from a tertiary referral care centre in Bangalore, India, with a confirmed diagnosis of CDH, who gave consent to participate, were recruited for the study. Patients with a primary diagnosis other than CDH (Chronic migraine or Chronic tension-type headache) were excluded from the study.

Quantitative

38 participants were interviewed with standardised assessment tools. The participants being recruited from a referral care centre, the population was diverse across educational, socio-economic and cultural background. Hence an interview was used as technique to collect data, so as to ensure uniformity and clarity. The measures were:

- Headache Assessment proforma prepared by the researcher and had details regarding the socio-demographic details, description of the headache episodes, precipitating, and relieving factors.
- Hamilton Depression Rating Scale (HDRS), 17 item version of HDRS assessing the symptoms of depression over the past week (14).
- Generalized Anxiety Disorder-7 (GAD-7), is a 7-item scale measured on a Likert scale, focusing on anxiety symptoms over the past 2 weeks with an additional question that looks at the impact on functionality (15).
- Perceived Stress Scale (PSS), is a widely used psychological measure for assessing the perception of stress. It measures to what extent the events in life are appraised as stressful (16).
- Brief Cope Inventory is a 28-item self-report questionnaire designed to measure effective and ineffective ways of coping with stressful life events. The scale has been widely used in health care settings (17).

The software Epinfo-7 (free software) was used to code and record the quantitative data. The results of the study were analysed using r software. The Shapiro-Wilk test was used to examine the headache duration frequency, pain intensity and the scores from the scales used in the study to test whether the distribution was normal. Descriptive statistics and inferential statistics were done and interpretations were drawn to understand the different variables of the study.

Qualitative

In-depth interviews were conducted with six participants with Chronic Daily Headache (both chronic migraine and chronic tension type headache) with the help of a topic guide. The topic guide had questions pertaining to the nature of headaches, impact of the condition etc. which was used as a prompt for the interview. Some of the questions from the topic guide were,

- Can you describe your headaches?
- How has the headaches impacted your personal life; can you give specific instances?
- How has the headaches impact your family, can you give some specific instances?
- How do you feel about your headaches?

The interviews were recorded and transcribed, and analysed using an inductive thematic analysis (18). The analysis was carried out manually. Each interview was analysed individually and the codes were created, then the themes were generated iteratively. The study used code saturation to determine the sample size of the qualitative phase of the study. The interviews were analysed in the order they were conducted. The first interview had both inductive and deductive codes. By the 5th interview majority of the codes for the study was developed. An additional
interview was carried out to ensure no new codes were emerging (19).

The ethical approval of the study was obtained from the NIMHANS Institutional Ethics Committee. Informed consent forms were developed, the study was explained in detail to the participants and option to withdraw from the study at any point was given before receiving consent.

Results

In this section the QUAN and QUAL findings of the study are presented separately. The results are integrated to explore the different factors contributing to primary headache disorders.

Quantitative Findings

Socio-Demographic and Headache Characteristics

The average age of the participants was 38.02 (±10.17), with the majority of the participants being females 31 (81.58%). 73.68% (28) of the participants were married. The mean duration of the illness was 8.63 (±4.73) years. The average headache days reported per month was 21.31 (±4.08) days. The mean pain intensity on a VAS scale between 1–10 was 7.34 (±0.66), indicating a high intensity of pain. Stress was the most reported precipitating factor and sleep was the most effective relieving factor (Table 1 and 2).

Depression and Anxiety

The mean score, on GAD was 11.92 (±1.92) indicating moderate levels of anxiety and on HDRS was found to be 11.05 (±2.47) indicating mild levels of depression.

The pain intensity scores were further grouped as ≤ 7 and >7. HDRS score differed between the groups with the ≤ 7 pain intensity group having higher median score (Wilcoxon test P ≤ .055). The headache days in a month was divided into three group pf 15–20 days, 21–25 days, and ≥26 days in a month. The HDRS score varied among the groups with the 21–25 days/month group showing higher median scores (Kruskal-Wallis test P ≤ 0.02).

There was variation in median GAD scores with photophobia (P ≤ .03). The HDRS scores were influenced by the associated symptoms, the presence of giddiness and fatigue increased the median HDRS score (Wilcoxon test P ≤ 0.02). The presence of photophobia also increased the median HDRS score (Wilcoxon test P ≤ .07).

Stress and Coping

The mean score on PSS was 21.52 (±2.93) indicating moderate levels of perceived stress. It was found that there were gender variations in the type of coping adopted with avoidant coping having higher median scores in women than in men. (Wilcoxon test P ≤ .08).

The coping pattern also changed with the pain intensity; it was found that in the ≤ 7 pain intensity group the median approach coping scores were higher. (Wilcoxon test P ≤ .02).

Correlation Analysis

On spearman correlation, it was found that GAD scores and PSS scores were positively correlated (r = 0.428 at P ≤ .007), GAD score and HDRS score were positively correlated (r =

| Variable | n (%) |
|----------|-------|
| Gender   |       |
| Male     | 7 (18.42) |
| Female   | 31 (81.58) |
| Education|       |
| Primary  | 8 (20.05) |
| Highschool| 17 (44.74) |
| Graduation and above | 13 (34.21) |
| Marital Status |       |
| Married  | 28 (73.68) |
| Unmarried| 6 (15.79) |
| Widowed  | 4 (10.53) |

Table 1. Socio-Demographic Variables.

| Variable | n (%) |
|----------|-------|
| Associated Symptoms |       |
| Nausea     | 31 (81.58) |
| Vomiting   | 15 (39.47) |
| Photophobia| 35 (95.11) |
| Phonophobia| 32 (84.21) |
| Giddiness and Fatigue | 16 (42.11) |
| Irritability| 9 (23.68) |
| Pain Distribution |       |
| Unilateral  | 17 (44.74) |
| Bilateral   | 16 (42.11) |
| Unilateral to Bilateral | 6 (15.79) |
| Type of Pain |       |
| Throbbing and Pulsating/hammering | 32 (84.21) |
| Heaviness and Band-like around the head | 6 (15.79) |
| Precipitating Factors |       |
| Stress      | 26 (68.42) |
| Exposure to sunlight/travelling | 18 (47.37) |
| Decreased Sleep | 14 (36.84) |
| Skipping meals | 14 (36.84) |
| Loud Sound  | 2 (5.26) |
| Specific smell | 1 (2.63) |
| Relieving factors |     |
| Massage and Balms | 5 (13.16) |
| Sleep       | 33 (86.84) |
| Analgesic use | 11 (28.95) |

Table 2. Headache Characteristics.
Table 3. Socio-Demographic Details.

| Participants | Age | Sex | Education | Occupation | Marital Status | Duration of the illness in years | Site/side of pain | Type of pain | Associated Symptoms | Diagnosis |
|--------------|-----|-----|-----------|------------|----------------|---------------------------------|-------------------|--------------|---------------------|-----------|
| P1           | 36  | F   | Highschool| Homemaker | Married        | 6                               | Unilateral (alternating from side to side) in the frontal and temporal region | Pulsating pulling | Nausea, vomiting, photophobia, phonophobia | Chronic migraine |
| P2           | 64  | M   | Post-Graduation | Retired | Married | 14 | Unilateral (mostly in the left side), Occipital region moving to the frontal and temporal region | Hammering Throbbing | Phonophobia, photophobia, nausea, occasional vomiting | Chronic Migraine |
| P3           | 29  | F   | Highschool| Homemaker | Married        | 10                              | Unilateral (alternating from side to side) in the occipital, temporal region and around the eyes | Throbbing hammering | Nausea, vomiting, photophobia, phonophobia | Chronic migraine |
| P4           | 38  | F   | Primary   | Homemaker | Married        | 15                              | Unilateral. Starts in the temporal region and moving towards the back of the head | Pulsating, throbbing | Phonophobia, photophobia, nausea, occasional vomiting | Chronic Migraine |
| P5           | 35  | F   | Highschool| Cook       | Widow          | 9                               | Bilateral. On the frontal and temporal region. | Heaviness of the head Pressing | Phonophobia, photophobia, occasional vomiting | Chronic Tension type headache |
| P6           | 31  | F   | Primary   | Homemaker | Married        | 5                               | Unilateral. The temples and around the eyes. | Pulsating hammering | Phonophobia, photophobia, occasional vomiting | Chronic Migraine |
0.37 at $P \leq .02$). The GAD score was positively correlated with the pain intensity score on VAS ($r = 0.50$ at $P \leq .001$).

**Qualitative Findings**

In this section the qualitative findings of the study are discussed. The socio-demographic and illness details of the participants are presented (Table 3).

**Emergent Themes**

Three main themes emerged from the qualitative phase of the study these were, **headache— an illness, headache factors and the impact.**

**Headache—An Illness**

Headache is a disorder that is characterised by episodes of pain and other symptoms.

**Headache Features.** Headache is described by a number of characteristics or features.

“my headache always starts in the left side... always my left side... it is so painful (pressing her head...). It is generally around my forehead and temples.... Mam the pain is so bad that I can't even lie down.... It hurts (pt. appears distressed and starts to cry)” – P3

“.... if it was only headaches also somehow managed... But headaches starts vomiting starts... can't eat anything....”- P 6

**Headache Can Increase.** Headache can become chronic, most participants report of their headaches changing and increasing over a period of time.

“.... My headaches are never the same... I usually get a one-sided headache that is generally very painful. But sometimes I have a dull ache also in my headache sometimes. The one-sided headache, doctors say it is migraine has increased now it comes everyday...” – P 2

**Lifestyle and Environmental Factors**

These are one of the most commonly reported triggers of headache disorders. Poor eating habits and skipping meals was reported by many participants as a trigger. A number of environmental factors such as travelling, being out in the sun were also frequently reported.

“... hmm... When I go out in the sun, taking head bath, travelling... I start having headaches.” – P 4

**Sleep and Headache**

Sleep is very essential for human beings. Irregular sleeping habits, poor sleep patterns are often reported triggering factors for headache disorders.

“Sleep is very important. I don’t sleep properly, the next day morning I get up with heavy head and blurry eyes. Within an hour I will have headaches- P 4

**Psychological Factors**

A number of psychological factors have been reported as precipitating factors for the headache disorders.

“.... When will I free from my headaches? I feel whatever do I am not going to free from these headaches. I feel a headache coming, I get so angry and frustrated. Then god.. the pain becomes more and more bad”- P 4

**Stress and Headaches**

Stress is one of the most commonly reported factors in headache condition. Perceived stress and the person’s reaction to the same can be a key factor.

“...I always get headaches when I worry about something... but you cant stop thinking for that na...”- P 6

**Socio-Cultural Factors**

There are a number of socio-cultural factors that contribute towards headache disorders. One of the most prominent is gender, socio-economic status and different kinds of vulnerabilities that add to the stress of headache disorders.

“..... I lost myself when I lost husband. I have to manage my kids, work etc etc... I cant stop to think about me right.....” - P 5

“... I am a man, I can’t have headaches. I cant say I am in pain, I am not supposed to cry...”- P 2
The Impact

The impact of headache disorders ranges from personal, familial, social and productive areas too.

Personal Impact of Headache Disorders

The presence of a chronic condition characterised by episodes of pain almost on an everyday basis has a direct impact on the person.

“I have almost forgotten who I am…. Pain, Pain Pain…. Every single day there is nothing much left in my life” P 4

“I know taking a lot of medicines is bad for my health but how is one to get away from this pain.”

Familial Impact of Headache Disorders

The headache disorders doesn’t only impact the person with headache disorders but also their families.

“I feel I am not good enough mother, which mother would be irritated with child, when he wants to play… headache make me like that” – P 3

Impact of Headache Disorders on Work and Employment

The presence of headache disorders intrudes into a person’s day to day activities and their productivity.

“I used to help my husband with farming when we both were working we had enough income. Nowadays, I don’t get work because I take too many leaves…..” - P 4

“I can’t afford the treatment for myself. One person earning and having to feed so many mouths.. Even buying headache medicines I have to think…” – P 4

Triangulation of the Results

The Figure 1 represents gives the triangulation of the findings. There were many convergent findings between the two phases of the study, the most outstanding of them were the descriptions of headache disorders, especially that of pain and the associated symptoms. The different triggers of headache especially the environmental and lifestyle factors, the importance of sleep and stress emerged clearly from both the phases of the study. Psychological factors such as anxiety and depression and their association with different dimensions of headache were highlighted in both phases.

The divergent factors were also noticeable. The qualitative phase highlighted significant number of the socio-cultural factors, and the familial impact of headache disorder. The quantitative phase of the study highlighted the relation between the psychological variables and the socio-demographic variables.

Discussion

The conceptualisation of headache disorders had been primarily biomedical. The main type of treatment focused upon is pharmacotherapy. But in the last decade the diverse nature of the triggers for headache disorders have highlighted the need for non-pharmacological therapy to work hand in hand with the medicines to improve treatment efficacy. Hence currently the conceptualisation of headache disorders have moved from a purely bio-medical model to a more broader bio-behavioural model of headache disorders (7,20). Present study attempted to find factors that are convergent and divergent in the biopsychosocial conceptualisation of headache.

The headache characteristics found in the study reveal the chronicity of the headache conditions and the delay in reaching proper treatment. In the study there emerged a rich understanding and description of pain, indicating a preoccupation with the pain experience. A survey of the chronic daily headache characteristics from a similar population found the age range to be 14–44 years, predominantly female gender and primarily chronic tension type headache. The most reported associated symptoms were vomiting, nausea, photophobia and phonophobia (21). Changing nature of the headaches leading to increase in intensity and frequency of headache often increased the distress. The nature of associated symptoms, especially vomiting, fatigue etc were more distressing than the pain itself (22).

Factors that precipitate a headache episode, the triggers, range from environmental factors such as travelling, being out in the sun; lifestyle factors such as skipping meals, poor sleep hygiene, erratic daily routine; psychological factors such as fear of pain, pain catastrophising or maximisation (23). A number of socio-cultural factors like interpersonal issues and major life events in the family context, poor understanding about headache disorders can also become a precipitating and maintaining factor (24).

Stress and sleep disturbance are the most reported trigger in all headache conditions, with more than 90% of patients reporting stress to affect at least some of their headache episodes. Stress is also associated with fear of pain and perceived inability to control pain sensation, leading to the overuse of analgesics leading to the worsening of CDH (25). Sleep was the most common relieving factor. Sleep has a bidirectional relationship with headaches. Sleep is seen both as a trigger and also the most common relieving factor too (26,27).
Dysfunctional coping behaviours have often been an important precipitating and maintaining factor. Pain cognitions and avoidance have been found to increase pain intensity and frequency of headaches (28). In the current study it was found that gender influences the type of coping adopted (29,30).

When headaches and psychiatric comorbidities are explored, a bidirectional relationship between headache, depression, and anxiety, as seen in other studies (31,32). In the current study, it was found that participants had mild/moderate depression, high levels of anxiety, and high levels of perceived stress. All the psychological variables significantly co-related with each other, influencing the headache event (33,34).

The qualitative findings mapped the multi-level impact of headache disorders on the person, which highlighted

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**Figure 1.** Triangulation of findings.

**Figure 2.** Bio-Psychosocial framework for chronic daily headaches.
the importance of socio-cultural factors that influence headache disorders. The constant presence of headache in their life affects the way they cope with the all the stressors in their life. The study confirms that there are a number of biological, psychological, environmental, lifestyle, socio-cultural factors that influence headache disorders. Understanding these factors would be necessary to address the multi-pronged impact of the condition. Engel’s bio-psychosocial model suggested that illness was an entity that is a constant interaction of biological, social, psychological and behavioural factors. Adapting this to chronic pain condition, pain is a convergence of biological, psychological and social processes (35). (Figure 2)

Strengths and Limitations
The main strength of the study is the inductively generated evidence to highlight the need for a broader and more inclusive biopsychosocial framework for chronic headache disorders (Figure 2). This framework would aid the practitioners to be sensitive to the presence of psychological factors that need to be explored, to understand the impact of headache conditions, keeping in mind the socio-cultural context and develop multi-component, wholistic interventions.

The main limitation of the study is the sample size that limits generalisability. The study was conducted among participants who reached out for management of their, headache which could have influenced the findings.

Conclusion
Headache disorders evolve from acute episodes and transform into chronic condition in the complex psychosocial context. Understanding this context helps us to build intervention that address these factors in turn improving the quality of life. Headaches hence can be best conceptualised in a bio-psychosocial model.

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ORCID iD
Priya Treesa Thomas https://orcid.org/0000-0003-2421-7303

Statement of Human Rights and Animal Rights
All the interviews with the participants were conducted in accordance with the institutional ethical guidelines of NIMHANS (Institute of National Importance), India, and approved by the institutional ethical committee, NIMHANS, India.

Statement of Informed Consent
Informed consent was obtained from all the participants of the study.

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Author Biographies

Bhuvaneshwari Balasubramanian is a Senior Research Scholar at the National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, India. She is currently pursuing her doctoral studies in the area of headache disorders, at the National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru. Her work in NIMHANS focusses on working with the psychosocial aspects of neurological conditions and especially Primary Headache Disorders.

Vasundharaa S. Nair is a Senior Research Scholar at the National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, India. She is currently pursuing her doctoral studies in the area of Acute Brain Infections, at the National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru. Her work in NIMHANS focusses on working with the psychosocial aspects of neurological condition especially in neurological emergency setting.

Nimmy George is research assistant at the National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, India. She has completed her master’s in microbiology, and her work in NIMHANS focuses on working with persons with headache disorders and stroke.

Ashok. V. Reddy is a Neurologist at the National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, India. He has completed his postdoctoral fellowship in Stroke from National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru. His areas of work focus on Stroke and Headache Disorders.

Priya Treesa Thomas is an Associate Professor of Psychiatric Social Work at the National Institute of Mental Health and Neurosciences, Bangalore, India. She was awarded PhD in Psychiatric Social Work from NIMHANS Bangalore in 2011, for her work with family caregivers of children with Duchenne Muscular Dystrophy. In NIMHANS, her work focuses on psychosocial assessment and interventions with patients and families of the neurologically ill.

Girish B. Kulkarni is a Professor of Neurology at the National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, India. He has completed his DM in Neurology from National Institute of Mental Health and Neurosciences. He was awarded fellowship in Stroke from Calgary Institute, Canada in 2017. His areas of expertise include Stroke and Headache disorders.