Sociocultural and familial factors associated with symptom experience at midlife among women in Nagaland, India

Peteneinuo Rulu

University of Massachusetts Amherst

Follow this and additional works at: https://scholarworks.umass.edu/dissertations_2

Part of the Biological and Physical Anthropology Commons

Recommended Citation
Rulu, Peteneinuo, "Sociocultural and familial factors associated with symptom experience at midlife among women in Nagaland, India" (2023). Doctoral Dissertations. 2983.
https://doi.org/10.7275/35832174 https://scholarworks.umass.edu/dissertations_2/2983

This Open Access Dissertation is brought to you for free and open access by the Dissertations and Theses at ScholarWorks@UMass Amherst. It has been accepted for inclusion in Doctoral Dissertations by an authorized administrator of ScholarWorks@UMass Amherst. For more information, please contact scholarworks@library.umass.edu.
SOCIOCULTURAL AND FAMILIAL FACTORS ASSOCIATED WITH
SYMPTOM EXPERIENCE AT MIDLIFE AMONG WOMEN IN NAGALAND,
INDIA

A Dissertation Presented
by
PETENEINUO RULU

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

September 2023

Anthropology
SOCIOCULTURAL AND FAMILIAL FACTORS ASSOCIATED WITH SYMPTOM EXPERIENCE AT MIDLIFE AMONG WOMEN IN NAGALAND, INDIA

A Dissertation Presented
by
PETENEINUO RULU

Approved as to the style and content by:

______________________________
Lynnette Leidy Sievert, Chair

______________________________
Jason Kamilar, Member

______________________________
Elizabeth R. Bertone-Johnson, Member

______________________________
Meenal Dhall, Member

______________________________
Julie Hemment, Department Head
Department of Anthropology
DEDICATION

To my dearest mother, for your constant support and sacrifices.

To my late father, for being an inspiration. Your legacy lives on through the values you instilled in us.
ACKNOWLEDGEMENTS

The process of writing this dissertation has been humbling, exhilarating, and a journey of self-discovery. Throughout, I often felt like this process is never-ending, and at times, I questioned my ability to see it through to completion. Fortunately, with the help and support of those whom I wish to acknowledge below, I was able to reach this point.

First and foremost, I am deeply indebted to my Chair, Prof. Lynnette Leidy Sievert, for her unwavering dedication and commitment to me over these years. She has been an instrumental mentor in my endeavors both academically and personally and I consider myself fortunate to have had her as my advisor. She is truly the best advisor any doctoral student could hope for.

I would also like to express my gratitude to my committee members, Jason Kamilar, Elizabeth R. Bertone-Johnson, and Meenal Dhall, for their constructive feedback and timely responses throughout my writing process. This dissertation would not have been possible without the unique perspectives and insights that you provided.

I am also grateful for the support of the Anthropology department at UMass Amherst, especially to the Chair, Julie Hemment, and administrative staff, Shelley Silva, Grace Rock, Beverley Morrison, and Danielle Sedelow, for helping me navigate through the administrative aspects of the Ph.D. program.

I wish to acknowledge the National Overseas Scholarship, Ministry of Tribal Affairs Government of India, Armelagos – Swedlund Dissertation Writing Fellowship, University of Massachusetts, Amherst Graduate School Fieldwork Grant, and Sigma Xi for their generous funding of my project.
I am deeply appreciative of the individuals who participated in my study and to those who helped me in the collection of my field data during the midst of the global COVID-19 pandemic in 2021, namely, Mrs. Janbeni, Mrs. Ranjam, Mr. Vilapra, and Mrs. Yambolo. Without your help, I would not have been able to collect the requisite field data to finish my dissertation.

I am thankful to my fellow cohort and colleagues, namely Meredith Degyansky, Cagla Ay, Tabitha Dorshorst, Catherine Kittrinos, and Seth Dornisch. I am especially grateful to Sofiya Shreyer for her exceptional kindness and encouragement. Her unwavering support and generosity have been invaluable, and I am truly grateful for her friendship. I would also like to express my gratitude to Eric Griffith for his insightful feedback on Chapter 4 of my dissertation.

Finally, I would like to thank my family and friends for their timely prayers, emotional support, and unconditional love. Their patience, encouragement, and understanding were invaluable in helping me stay focused and motivated throughout this process.
ABSTRACT

SOCIOCULTURAL AND FAMILIAL FACTORS ASSOCIATED WITH SYMPTOM EXPERIENCE AT MIDLIFE AMONG WOMEN IN NAGALAND, INDIA

SEPTEMBER 2023

PETENEINUO RULU, B.S., NAGALAND UNIVERSITY, INDIA
M.S., UNIVERSITY OF DELHI, INDIA
MPhil., UNIVERSITY OF DELHI, INDIA
Ph.D., UNIVERSITY OF MASSACHUSETTS AMHERST

Directed by: Professor Lynnette Leidy Sievert

This cross-sectional study examines the sociocultural and familial factors that are associated with symptom experience at midlife among women in Nagaland. More specifically, the study examines the factors associated with symptoms at midlife, the relationship between symptoms at midlife, household stressors, ethnopolitical problems, and various measures of stress, and the buffering effects of social support against the negative effects of stress on symptoms at midlife. Data from 151 women aged 40-55 were collected from 4 regions in Nagaland, India. The most common symptoms reported during the past two weeks were headaches (72%), tiredness or lack of energy (67.5%), and hot flashes (58.3%). The study revealed a significant positive correlation between a composite measure of emotional instability ($\beta=0.46$, $p<0.001$) and mood disturbances ($\beta=0.24$, $p<0.05$), and stress assessed by fingernail cortisol. This relationship persisted after controlling for body mass index (BMI), socioeconomic status (SES), and menopausal status. Additionally, household problems were positively associated with fingernail cortisol ($\beta=0.25$, $p=0.01$). Moreover, after adjusting for menopausal status,
tobacco use, BMI, and socioeconomic status, cortisol level was positively associated with emotional instability (p<0.01), vaso-somatic symptom score (p=0.05), and total symptoms at midlife (p=0.05). Familial support was negatively associated with emotional instability (p<0.05) and total symptoms at midlife (p<0.05). More interestingly, a buffering effect between support from spouse, perceived stress, and vaso-somatic symptoms was observed, supporting the hypothesis that higher levels of support may mitigate the impact of stress on vaso-somatic symptoms among women in Nagaland.

Overall, these findings highlight the potential health impacts of the psychosocial stress response associated with domestic stressors such as financial strain and concerns about children and health, and the importance of considering multiple sources of stress when assessing their impact on emotional and physiological well-being. The study further illustrates the importance of family ties and support for navigating the stressors of everyday life among midlife women in Nagaland.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>ACKNOWLEDGEMENTS</th>
<th>v</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>xii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xiii</td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS</td>
<td>xiv</td>
</tr>
</tbody>
</table>

## CHAPTER

### 1. INTRODUCTION

- Menopause overview ........................................................................ 1
- Physiology of menopause .................................................................. 2
- Age at menopause ............................................................................. 4
- Stages of menopause ........................................................................ 6
  - Reproductive .................................................................................. 7
  - The menopausal transition ............................................................ 8
  - Postmenopause ............................................................................. 8
- Symptoms of menopause .................................................................... 8
- Stress and menopause ...................................................................... 11
  - Physiology of stress ..................................................................... 12
  - Measures of stress ....................................................................... 13
    - Fingernail cortisol .................................................................... 13
    - Blood pressure .......................................................................... 15
    - Perceived stress ....................................................................... 16
- Stressors ......................................................................................... 17
  - Community stressors .................................................................... 17
  - Household stressors ..................................................................... 20
- Social support ................................................................................ 22
- Biocultural perspectives .................................................................. 25
- Aims and objectives ......................................................................... 28
- Significance of the study ................................................................. 29

### 2. METHODS

- Study area and the people ............................................................... 32
  - Political and administrative organization .................................... 38
  - Religion ....................................................................................... 41
  - Naga household ............................................................................ 43
- Data collection ................................................................................ 46
  - Data collection procedures ......................................................... 51
    - Height .......................................................................................... 51
    - Bodyweight ................................................................................ 52
    - Waist circumference ................................................................. 52
3. FACTORS ASSOCIATED WITH SYMPTOMS AT MIDLIFE IN NAGALAND, INDIA

Introduction ........................................................................................................ 57
Methods ............................................................................................................. 60
    Participant selection and recruitment ......................................................... 60
    Menopause status and symptoms at midlife .............................................. 60
    Objective hot flashes and night sweats ....................................................... 61
    Socio-demographic variables and lifestyle variables .............................. 62
    Perceived stress ......................................................................................... 63
    Statistical analysis .................................................................................... 63
Results ............................................................................................................ 65
Discussion and conclusion ................................................................. 73

4. MIDLIFE SYMPTOMS AND HOUSEHOLD STRESS ARE ASSOCIATED WITH FINGERNAIL CORTISOL

Introduction ........................................................................................................ 76
Methods ............................................................................................................. 80
    Markers of stress ....................................................................................... 81
        Fingernail cortisol ................................................................................. 81
        Blood pressure ..................................................................................... 81
        Perceived stress .................................................................................. 82
    Stressors ..................................................................................................... 82
        Menopausal symptoms ........................................................................ 82
        Household stressors ........................................................................... 83
        Community stressors ......................................................................... 83
    Covariates ................................................................................................. 84
    Statistical analysis .................................................................................... 84
Results ............................................................................................................ 85
Discussion and conclusion ................................................................. 92

5. CHRONIC STRESS, SOCIAL SUPPORT AND MENOPAUSAL SYMPTOMS. IS THERE A BUFFERING EFFECT?

Introduction ........................................................................................................ 96
Methods ............................................................................................................. 99
    Study design and participants ................................................................... 99
    Menopause status and symptoms ............................................................ 99
    Markers of stress ....................................................................................... 100
    Perceived social support ......................................................................... 101
Sociodemographic variables.............................. 102
Statistical analysis........................................ 102
Results...................................................... 103
Discussion............................................... 118
Conclusion............................................... 121

APPENDIX: QUESTIONNAIRES........................... 122
BIBLIOGRAPHY........................................... 130
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 3.1: Contending models</td>
<td>65</td>
</tr>
<tr>
<td>Table 3.2: Summary statistics</td>
<td>66</td>
</tr>
<tr>
<td>Table 3.3: Frequency of symptoms at midlife</td>
<td>68</td>
</tr>
<tr>
<td>Table 3.4: New symptom lists among women in Nagaland</td>
<td>69</td>
</tr>
<tr>
<td>Table 3.5: Factor loadings for symptoms at midlife</td>
<td>70</td>
</tr>
<tr>
<td>Table 3.6: Models showing AICc weights for biometrically measured and self-reported subjective vasomotor symptoms</td>
<td>71</td>
</tr>
<tr>
<td>Table 3.7: Standardized estimates for biometrically measured and self-reported subjective vasomotor symptoms</td>
<td>72</td>
</tr>
<tr>
<td>Table 4.1: Sample characteristics</td>
<td>86</td>
</tr>
<tr>
<td>Table 4.2: Blood pressure category</td>
<td>86</td>
</tr>
<tr>
<td>Table 4.3: Correlation between variables of interest</td>
<td>88</td>
</tr>
<tr>
<td>Table 4.4: Multiple linear regression for stress indicators</td>
<td>88</td>
</tr>
<tr>
<td>Table 4.5: Logistic regression for blood pressure and stressors</td>
<td>90</td>
</tr>
<tr>
<td>Table 5.1: Descriptive statistics</td>
<td>104</td>
</tr>
<tr>
<td>Table 5.2: Correlations between continuous variables</td>
<td>106</td>
</tr>
<tr>
<td>Table 5.3: Base model measuring symptom severity using multiple linear regression</td>
<td>108</td>
</tr>
<tr>
<td>Table 5.4: Factor loading for social support</td>
<td>111</td>
</tr>
<tr>
<td>Table 5.5: Multiple linear regression model with high social support</td>
<td>112</td>
</tr>
<tr>
<td>Table 5.6: Multiple linear regression model with low support</td>
<td>113</td>
</tr>
<tr>
<td>Table 5.7: Multiple linear regression model with high family support</td>
<td>114</td>
</tr>
<tr>
<td>Table 5.8: Multiple linear regression model with low family support</td>
<td>115</td>
</tr>
<tr>
<td>Table 5.9: Multiple linear regression model with high support from friends</td>
<td>116</td>
</tr>
<tr>
<td>Table 5.10: Multiple linear regression model with low support from friends</td>
<td>117</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1: The STRAW-10 staging system ................................................................. 7
Figure 2: Cortisol deposition in fingernail ............................................................... 14
Figure 3: Map of Nagaland ................................................................................... 34
Figure 4: Views of Kohima (a & b) and Dimapur (c) ............................................. 36
Figure 5: Views of Mima village ........................................................................... 37
Figure 6: Views of Shaki village ............................................................................ 38
Figure 7: (a) participants wearing Biolog monitors; (b) blood pressure reading .................................................................................................................. 51
Figure 8: Participant wearing Biolog monitor, with electrodes placed 4 inches apart on both sides of the sternum ............................................................. 56
Figure 9: Objective VMS experience recorded by Biolog monitor ..................... 67
Figure 10: Word cloud showing specific household stressors ............................. 91
## LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTH</td>
<td>Adrenocorticotropic hormone</td>
</tr>
<tr>
<td>ADC</td>
<td>Additional Deputy Commissioner</td>
</tr>
<tr>
<td>AMH</td>
<td>Anti-Müllerian Hormone</td>
</tr>
<tr>
<td>BDI</td>
<td>Beck’s Depression Inventory</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>CAA</td>
<td>Citizen Amendment Act</td>
</tr>
<tr>
<td>COVID-19</td>
<td>Corona Virus Disease-19</td>
</tr>
<tr>
<td>CRH</td>
<td>Corticotropin-releasing hormone</td>
</tr>
<tr>
<td>DC</td>
<td>District Commissioner</td>
</tr>
<tr>
<td>EAC</td>
<td>Extra Assistant Commissioner</td>
</tr>
<tr>
<td>FSH</td>
<td>Follicle-stimulating hormone</td>
</tr>
<tr>
<td>GCS</td>
<td>Greene Climacteric Scale</td>
</tr>
<tr>
<td>GnRH</td>
<td>Gonadotropin-releasing hormone</td>
</tr>
<tr>
<td>HPA</td>
<td>Hypothalamic-pituitary-adrenal axis</td>
</tr>
<tr>
<td>LH</td>
<td>Luteinizing hormone</td>
</tr>
<tr>
<td>MLA</td>
<td>Members of Legislative Assembly</td>
</tr>
<tr>
<td>MSPSS</td>
<td>Multidimensional Scale of Perceived Social Support</td>
</tr>
<tr>
<td>NNC</td>
<td>Naga National Council</td>
</tr>
<tr>
<td>NSCN</td>
<td>National Socialist Council of Nagalim</td>
</tr>
<tr>
<td>PSS</td>
<td>Perceived stress</td>
</tr>
<tr>
<td>RD blocks</td>
<td>Rural Development blocks</td>
</tr>
<tr>
<td>SDO</td>
<td>Sub-division Officer</td>
</tr>
<tr>
<td>SNS</td>
<td>Sympathetic Nervous System</td>
</tr>
<tr>
<td>STRAW</td>
<td>Stages of Reproductive Aging Workshop</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>UFC levels</td>
<td>Urine free cortisol levels</td>
</tr>
<tr>
<td>VDB</td>
<td>Village development board</td>
</tr>
<tr>
<td>VMS</td>
<td>Vasomotor symptoms</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

Menopause Overview

Midlife is a central period of one’s life when, for many, changes in physiology lead to stressful life experiences. One such experience is menopause. Menopause is an important transitional event that all women undergo, which marks the end of reproductive life and the beginning of post-reproductive life in both humans and some other mammals (Cohen 2004). The World Health Organization (1981) defines menopause as the “permanent cessation of menstruation resulting from the loss of ovarian follicular activity”. Menopause has been described both as an event and a process (Sievert 2006): an event, following the last menstrual period, and a process, transitioning from premenopausal to postmenopausal life. Either way, menopause is painted as an important marker for future poor health outcomes (Gold et al. 2013).

Although menopause had historically been viewed as a “disease” (Singh et al. 2002), this view has changed over the years. Menopause is a natural event associated with the depletion of follicles in the ovaries, resulting in reduced functioning of the ovaries and lower levels of estrogen, and can also be induced when the ovaries are damaged by radiation, chemotherapy, or other medical conditions. The physiology of menopause is complex, and there is still much that we do not yet understand. For instance, the transition from the reproductive to the post-reproductive period lasts a long time, making it difficult for researchers to collect sufficient longitudinal data. Additionally, while menopause is a universal event, the process can be altered or modified by technology or medical procedures (e.g., oophorectomy/ hysterectomy).
Furthermore, it is difficult to tease apart the effects of physical aging and reproductive aging because the effects of both processes overlap. Finally, there is significant variation due to cultural and environmental factors.

In this chapter, I will explore the physiology of menopause, including the hormonal changes that occur and how they impact a woman’s body. I will also examine the different stages of menopause, including pre-, peri-, and post-menopause, and explain the average age of onset of menopause. Additionally, I will discuss the various symptoms that women may experience during this time, such as hot flashes and night sweats, and review factors associated with these symptoms, especially stress. I will also identify different stressors from the household as well as the community level to explore how these stressors associate with menopause. More importantly, the role of social support among women in Nagaland, India, will be explored in relation to menopause. Finally, I will incorporate the biocultural perspective to examine how women in Nagaland go through midlife.

**Physiology of menopause**

Women’s reproductive physiology is regulated through the hormonal interaction between the hypothalamus\(^1\), anterior pituitary gland\(^2\), and ovaries. During a normal menstrual cycle, hormones are secreted through combined negative and positive feedback mechanisms. This process begins in the hypothalamus, where gonadotropin-releasing hormone (GnRH) – a peptide hormone – is secreted in an increased, pulsatile manner following the onset of puberty. This hormone is then transported to the anterior pituitary

---
\(^1\) Hypothalamus is the region in the ventral brain that coordinates the endocrine system and functions in conjunction with the pituitary gland through the hypothalamic-pituitary axis (Shahid & Singh 2018).
\(^2\) The anterior pituitary gland is the front lobe of the pituitary gland which helps in regulating the functions of various other endocrine glands and maintaining overall hormone levels in the blood.
gland, where it activates the 7-transmembrane G-protein receptor\(^3\), signaling the gland to release follicle-stimulating hormone (FSH) and luteinizing hormone (LH). These hormones then stimulate the ovaries, which have two types of cells that produce hormones – theca cells and granulosa cells. LH activates the theca cells to produce progesterone and androstenedione through cholesterol desmolase enzyme activation (Raju et al. 2013). Androstenedione is then transported to nearby granulosa cells where FSH activates the enzyme aromatase, causing the conversion of androstenedione to testosterone and 17-beta-estradiol – the primary female hormone (Owen Jr. 1975; Silberstein & Merriam, 2000).

As women grow older and their ovaries age, their reaction to pituitary gonadotropins such as FSH and LH diminishes. This leads to a shorter follicular phase (Klein et al. 1996; Lenton et al. 1991), resulting in shorter and less regular menstrual cycles. Another noticeable indication of reproductive aging is the increase in FSH levels without a corresponding increase in LH (Klein et al. 1996; Lee et al. 1988; MacNaughton et al. 1992). The high surge in FSH levels is maintained in the absence of negative feedback from the ovary. On the other hand, as the number of viable follicles decreases, there is very little estradiol production as the remaining follicles stop responding. Although estrogens can also be produced by peripheral tissues (Nelson & Bulun, 2001), the total estrogen level gradually decreases, with estrone replacing estradiol as the most common estrogen (Korenman et al. 1978).

---
\(^3\) Also known as G-protein-coupled receptor, it is a type of receptor protein located on the cell membrane and is involved in numerous physiological processes such as neurotransmission and hormone regulation.
Age at menopause

The menopausal transition is marked by increased variability in the menstrual cycle length, fluctuations in hormonal levels, and increased prevalence of amenorrhea (Harlow et al. 2012). Generally, this transitional phase that women experience can range anywhere from their 40s to 50s, but it has been shown to start even earlier (Faubion et al. 2015; Ossewaarde et al. 2005; Shifren et al. 2014; WHO, 1996; Wu et al. 2014). For example, in Western countries, the average age at menopause is 51.4 years (Henderson et al. 2008), but averages can vary from 48 to 53 years (Gold et al. 2013; Morabia et al. 1998; Murphy et al. 2013; Sievert et al. 2013).

The age at menopause can be determined in retrospect by asking postmenopausal women to recall their age at the time of the last menstrual period, or by periodically asking women about the presence or absence of menstrual cycles (WHO, 1981). However, these methods may be subject to biased reporting. Alternative techniques involve the use of hormone tests such as FSH and anti-Müllerian hormone (AMH), to estimate or predict age at menopause. While FSH levels remain consistently high during the years approaching menopause and can be used to determine menopause, this method is limited as FSH measures ovarian reserve indirectly because it is a pituitary hormone and not an ovarian hormone, additionally, FSH relies heavily upon changes in estradiol and the inhibins, and their levels fluctuate throughout the menstrual cycle (Roudebush et al. 2008). In contrast, AMH provides a more advantageous index of ovarian aging than FSH, as it is produced by the antral follicles[^1] and provides a direct measure of ovarian aging.

[^1]: A small, fluid-filled sac inside the ovary that contains an egg. Antral follicles are a stage of follicular development. They have lots of granulosa and thecal cells and, yes, a lot of fluid within the follicle alongside the oocyte, but they are more than fluid-filled sacs.
activity and maintains stable levels across the menstrual cycle (Finkelstein et al. 2020). For instance, results from the Penn Ovarian Aging Study indicated that AMH is a strong predictor of median time to menopause in late reproductive age women. Specifically, for every one standard deviation increase in AMH, the risk of menopause decreased by 44% (hazard ratio, 0.56; CI, 0.47–0.67; P < 0.0001) (Freeman et al. 2012).

The timing of the onset of menopause is an important risk factor in studies of older women’s health. For instance, earlier age at menopause has been associated with cardiovascular diseases (El Khoudray 2020; Hu et al. 1999; Rocca et al. 2012; Shen et al. 2020; van der Schouw et al. 1996; Zhu et al. 2019), and bone loss and osteoporosis (Aloia et al. 1985; Pouilles et al. 1994). On the other hand, later age at menopause has been associated with an increased risk of breast (Kelsey et al 1993; Trichopoulos et al. 1972), endometrial (McPherson et al. 1996; Wu et al. 2019), and ovarian cancer (Booth et al. 1989; Reid et al. 2017). Studies have indicated that age at menopause can vary by ethnicity, age at menarche, and demographic and lifestyle factors such as smoking, education, and parity (Bromberger et al. 1997; Gold et al. 2001, 2013; Henderson et al. 2008; Mishra et al. 2017; Sievert & Hautaniemi, 2003). A cross-sectional investigation of the British Women’s Heart and Health study found that indicators of adverse socio-economic position in childhood and adulthood, including lack of access to bathroom facilities and hot water within the house, sharing of bedrooms, and lack of car accessibility, were associated with an earlier age at menopause, such that women with the most deprived backgrounds experienced menopause at an earlier age (Lawlor et al. 2003).
The World Health Organization (1996) identifies the different stages of menopause as premenopause, perimenopause, and postmenopause. Premenopause encompasses the reproductive years prior to menopause. Perimenopause refers to the period immediately prior to menopause characterized by biological, endocrinological, and clinical features associated with menopause, and extending until after the first year after menopause. Postmenopause, on the other hand, refers to the time after the final menstrual period.

To address the need for a proper staging system for female reproductive aging, the Stages of Reproductive Aging Workshop (STRAW) was convened in 2001 in Park City, Utah, USA (Soules et al. 2001). Based on STRAW, a women’s life is divided into three broad categories namely, reproductive (stage -5 early, stage -4 peak, stage -3 late), the menopausal transition (stage -2 early and stage -1 late), and postmenopause (stages +1 early and stages+2 late). These phases were centered on the final menstrual period (FMP) and included a total of seven stages. In 2011, a revised version of the STRAW, known as STRAW+10 was established and has since been used as a gold standard for menopause staging (Harlow et al. 2012), including in my own research where I employed this staging. This updated system provides a more comprehensive and detailed structure, incorporating qualitative measures for biomarkers during the later stages of reproductive life. A brief description of this staging system is presented below.
**Figure 1: The STRAW-10 staging system (Harlow et al. 2012)**

**Reproductive**

The reproductive stage is divided into 3 sub-stages namely, early, peak, and late reproductive stages. Throughout these reproductive years, menstrual cycles are typically regular, with some variability towards the beginning after menarche, as well as minor changes in flow (either lighter or heavier) and duration (either shorter or longer). During the late reproductive stage, levels of AMH, inhibin B, and antral follicle count are low and FSH levels may be variable in blood samples collected between days 2 and 5 of the menstrual cycle.
The menopausal transition

The menopausal transition stage is further divided into early and late menopausal transition and begins when perimenopause occurs. Initially, the menstrual cycle varies in duration, and the length of time between menstruations differs by seven or more days each cycle. As this stage progresses, women typically experience amenorrhea for 60 or more days and the late menopausal transition phase may last for one to three years. During this stage, laboratory tests may reveal a variably elevated FSH level in the early menopausal transition stage, and a higher FSH level greater the 25 IU/L later. AMH, inhibin B, and antral follicle count remain low. Additionally, women may experience vasomotor symptoms at this stage.

Postmenopause

The postmenopause stage is also divided into early and late stages. During this phase, menstrual cycles come to a halt, and perimenopause persists until there has been no menstrual bleeding for 12 consecutive months, following which early postmenopause lasts for another year. This duration is characterized by elevated and variable levels of FSH, while inhibin B, and Antral follicle count remain low. During this time, women are more susceptible to experiencing vasomotor symptoms. As the postmenopause phase advances, FSH levels stabilize, and AMH, inhibin B, and antral follicle count decline significantly. After 3 to 6 years, women progress to the late postmenopause stage, where they may experience more symptoms related to urogenital atrophy.

Symptoms of menopause

During the menopausal transition period, women experience symptoms that can affect the overall quality of their lives. These symptoms may include mood changes, hot
flashes, sleeplessness, anxiety, and difficulty concentrating. Most women report symptoms during the menopausal transition and these symptoms can last for up to 10 years after menopause (Avis et al. 2015; Hunter et al. 2012), although these symptoms can vary widely across populations, ethnicities, and individuals (Melby et al. 2011; Obermeyer, 2000; Sievert, 2006). Therefore, to understand the symptomology of menopause, factors such as one's ethnicity, diet, language, beliefs, symbolic meanings, personal expectations, self-esteem, and changes in social roles should be taken into consideration, which has been called for by prior research (Feltrin & Velho, 2014).

Symptoms of menopause can be broadly categorized into somatic, psychological, and vasomotor symptoms (VMS). Somatic symptoms include symptoms such as dizziness, headaches, numbness, breathing difficulties, and muscle or joint pains; psychological symptoms include sleep difficulties, anxiety and panic attacks, depressed moods, and nervousness; and VMS includes hot flashes and night sweats (Greene, 1976). Among the most common symptoms reported by women during the menopausal transition are the VMS (about 80%) and sleep disturbances (Adhi et al. 2007; Gold et al. 2006; Handley & William, 2015; Rizk et al. 1998). Although VMS that occur during menopause or the menopausal transition are not thought to be detrimental, they can induce other existing health problems. For instance, women around the globe have reported disturbances in day-to-day activities because of flushing and perspiration, sleep disturbances, irritability, labile moods, and anxiety (Handley & Williams, 2015; Huang et al. 2008). As such, VMS are one of the most common reasons why women seek health care during or around menopause (Williams et al. 2007).
While hot flashes are often thought to be the most frequently reported symptom by women, with variation in intensity, duration, and frequency (Santoro et al. 2015), some studies in the Indian subcontinent suggest otherwise (Bairy et al. 2009; Doetale et al. 2015; Poomalar & Arounassalame, 2013; Singh & Pradhan, 2014). India is one of the most diverse countries in the world. One reason is because of the complex amalgamation of diverse cultural identities fostered by different religious beliefs, languages, ethnic groups, and geographies. Hence, variations in symptom experience are observed even among different communities in India. For instance, in Maharashtra, the most common symptoms at midlife were joint pains followed by urological symptoms (Deotale et al. 2015); in Pune, loss of interest in most things (93%) followed by pressure/tightness in the head (83%) were more common (Bagga, 2004); and in Jammu, fatigue and lack of energy (72.93%) followed by headaches (55.9%) were commonly reported (Sharma et al. 2007). Furthermore, studies have also shown that the frequency with which Indian women report menopausal symptoms varies with culture and sociodemographic status (Kakkar et al. 2007; Syamala & Sivakami, 2005).

Although the literature on menopausal studies in the Indian population is immense, few studies have addressed the issues of menopausal experience among indigenous ethnic groups. Indigenous ethnic groups in India constitute about 104 million people (Census, 2011) and are spread across different regions defined by various cultures, languages, religions, and ethnic backgrounds. A nationwide study on menopause reported a higher prevalence of symptoms and an earlier onset of menopause associated with being an agriculturist, lacking education, belonging to a scheduled caste or scheduled tribe, being underweight, having higher parity, and the attainment of motherhood before
age 16 (Mozumdae & Agrawal, 2015). Thus, it is important to study menopause among tribal populations in the Indian subcontinent.

**Stress and menopause**

The menopausal transition, a time of significant hormonal changes, can have a profound impact on a woman’s emotional and psychological well-being, leading to an increased risk of stress and anxiety. For instance, Bauld and Brown’s (2009) study indicated a significant association between menopausal symptoms and physical health, and factors such as high-stress levels, anxiety, and depression, low social support (both in quantity and quality), low levels of proactive coping and emotional intelligence.

According to a review article by Maki et al. (2019), out of 11 longitudinal studies reviewed, more than half (54%) suggest an elevated risk of depressive symptoms during the menopausal transition. These studies estimate higher odds of experiencing depressive symptoms ranging from 1.30 to 1.55 during the early transition and 1.71 to 2.89 during the late transition.

Estrogen is known to have a mood-regulating effect, and its lack can lead to a range of emotional symptoms (Gordon et al. 2016; Halbreich & Kahn, 2001), but not all findings associate menopausal symptoms with estrogen deficiency (Brown et al. 2009; Gracia et al. 2005). This is perhaps, due to the combined effects of hormonal fluctuations or decline, the physical aging process, and social factors such as becoming a grandmother and losing a loved one. In addition, sleep disturbances, hot flashes, and night sweats can also cause physical discomfort and contribute to stress and anxiety (Bromberger & Matthews, 1996; Hunter et al. 2004). Likewise, the impact of stress on menopausal symptoms can create a vicious cycle. Stress can exacerbate menopausal symptoms such
as hot flashes and night sweats (Arnot et al. 2021; Cuadros et al. 2012; Swartzman et al. 1990).

Stress is a state of disharmony that arises when different physical, environmental, or psychological stressors disrupt the body’s equilibrium. Lazarus & Folkman (1984) describe stressors as a potential danger to physical integrity or psychological well-being. Numerous measures have been employed to assess the impact of stress on menopause, ranging from retrospective assessments of exposure to adverse events such as famine (Elias et al. 2003), abuse during childhood (Carson & Thurston, 2019; Kapoor et al. 2021), and neighborhood stress (Gerber & Sievert, 2018). This dissertation investigates the interrelationships among everyday stressors (i.e., stressors arising from household and community-related factors) and menopausal symptoms, as well as their associations with perceived and biological indicators of stress and social support.

**Physiology of stress**

In response to stress, the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system (SNS) are activated, resulting in a physiological change or adaptation so the organism can deal with the threat (Maier & Watkins, 1998). When faced with a threat, the hypothalamus releases a hormone called corticotropin-releasing hormone (CRH) that stimulates the pituitary gland to release adrenocorticotropic hormone (ACTH) into the bloodstream. ACTH then travels to the adrenal glands, which are located on top of the kidneys, and stimulates the release of cortisol – a stress hormone (Miller & O’Callaghan, 2002). Cortisol is a steroid hormone that helps in mediating the stress response and regulates metabolism, inflammatory responses, and immune function (Oakley & Cidlowski, 2013). In the study of menopause and its associated symptoms,
cortisol has been widely studied as an indicator of stress (Gordon et al. 2019; Gerber et al. 2017; Patacchioli et al. 2006; Woods & Mitchell, 2011; Woods et al. 2006, 2009). Cortisol levels can be measured in blood (Katainen et al. 2018), urine (Cagnacci et al. 2011; Woods et al. 2006), saliva (Gerber et al. 2017; Patacchioli et al. 2006), and fingernails (Jankovic-Rankovic et al. 2020).

**Measures of stress**

Stress can be measured with different methods, including self-reported questionnaires (e.g., Perceived Stress Scale-10; Cohen et al. 1994) and biomarkers (e.g., cortisol levels and blood pressure). In this dissertation, stress was measured using fingernail cortisol, blood pressure, and perceived stress. Fingernail samples for cortisol measurement were used due to their non-invasive nature, cultural acceptability, and cost-effectiveness when compared to salivary samples. Additionally, cortisol concentrations derived from saliva reflect a relatively short time frame of a few days and require repeated measurements over several days to obtain average chronic concentrations (Wosu et al. 2013). Therefore, the ease of collecting and storing fingernail samples makes them a reliable option. Nail cortisol levels represent an accumulation of cortisol output over several months (Warnock et al. 2010) and, therefore, is an ideal candidate for measuring chronic stress, which is the goal of this study.

**Fingernail cortisol**

Previous studies have demonstrated that cortisol levels in nails and hair exhibit similar concentrations and degrees of variation (Hubmann et al. 2016; Nejad et al. 2016) and have also been found to correlate with salivary cortisol levels throughout the day (Izawa et al. 2015). Additionally, studies have reported a positive association between
perceived stress and heightened levels of cortisol in nails (Izawa et al. 2017; Nejad et al. 2016; Warnock et al. 2010; Wu et al. 2018). Thus, cortisol seems to be a reliable measure of chronic stress.

Cortisol and other hormones are deposited in the nail through the nail matrix through a process called keratinization. Keratinization is the process by which cells in the nails are transformed into a protein called keratin. As the nails grow, the keratinized cells are pushed out of the matrix (the base of the nail) and become the visible part of the nail. Cortisol is embedded in the nails as they grow, so cortisol levels in the nails can provide a record of cortisol levels over a period of time. Fingernails grow faster than toenails and grow at an average rate of 3.5 mm per month. Therefore, cortisol levels in fingernails can be used to assess cortisol levels over the past 3-6 months (de Barker & Baran, 2007). The rate of nail growth can exhibit variations based on factors such as seasonal fluctuations, gender, use of nail filing, and tendency towards nail-biting behavior (de Barker & Baran, 2007; Gupta et al. 2005).

![Cortisol deposition in a fingernail](fruge2017image)

Figure 2: Cortisol deposition in a fingernail (Frugé et al. 2017)
In a study by Gibson et al. (2016), dysregulation of hair cortisol levels was linked to hot flashes. In particular, higher exposure to cortisol was found to be associated with a greater frequency of hot flashes. Similarly, research conducted in Saskatchewan, Canada demonstrated a link between a blunted cortisol awakening response from saliva samples and the frequency and severity of VMS, which was independent of reproductive hormone levels and sleep disruption (Sauer et al. 2020). In another study, menopausal symptoms, as measured by the Greene Climacteric Scale, were linearly related to 24-h urinary cortisol ($\beta=2.46$, $p=0.0001$). More interestingly, after 3 months of treatment with either estrogen-progestin therapy, phytoestrogens, or acupuncture, changes in 24-hr cortisol values were linearly related to the change of total Greene’s climacteric scale score with a mean change unit score ($\beta$) of 2.10 and $p$-value of 0.012 (Cagnacci et al. 2022). In contrast, some studies did not observe any association between cortisol and menopause symptoms (Gerber et al. 2017; Woods et al. 2009). To my knowledge, this is the first test of the relationship between symptoms at midlife and fingernail cortisol levels.

**Blood pressure**

During menopause, the decline in estrogen levels can lead to vasoconstriction, which may result in an increase in blood pressure, as documented in various studies (Miller & Duckles, 2008; Rodrigues et al., 2022; White, 2002). Furthermore, the common occurrence of weight gain during menopause can also contribute to the onset of hypertension, as reported in studies by Kodoth et al. (2022) and Wing et al. (1991). Hot flashes have also been suggested to be a marker for elevated blood pressure in some studies (Baker et al., 2019; Brown et al., 2011; Gerber et al., 2007; Jackson et al., 2016; James et al., 2004). For instance, Gerber and colleagues (2007) reported a significantly
higher mean awake and sleep systolic blood pressure in women who reported experiencing hot flushes even after controlling for independent variables. A Japanese study examining the association between psychological and physical stress, cardiovascular responses, and oxidative stress in premenopausal and postmenopausal women demonstrated that mental stress caused a sustained increase in diastolic blood pressure in postmenopausal women, accompanied by heightened oxidative stress, while physical stress did not have a similar effect (Morimoto et al., 2008). Among Koreans, an association between blood pressure and menopausal status was identified with significantly higher blood pressure levels observed among women in the late menopausal transition period compared to the early menopausal transition period. Additionally, VMS was found to be related to diastolic blood pressure, but not systolic blood pressure and hypertension (Son et al. 2015). On the contrary, studies by Cagnacci et al. (2012) and Lee et al. (2011) did not find an association between blood pressure and menopausal symptoms.

**Perceived stress**

Perceived stress refers to an individual’s personal experience of the stressors and their perceived ability to cope with them. Perceived stress can be measured with the help of questionnaires (e.g., PSS-10, Cohen et al. 1994). Studies suggest that perceived stress are associated with menopause symptoms such as hot flushes, night sweats, and mood changes (Alexander et al. 2007; Freeman et al. 2007; Nosek et al. 2010; Sievert et al. 2018). For instance, results from the Penn Ovarian Aging Study (Freeman et al. 2007) indicated that perceived stress had the strongest association with symptoms such that higher stress was significantly associated with hot flushes (p=0.007), aches, joint pain,
and stiffness (p<0.001), depressed mood (p<0.001), poor sleep (p<0.001), decreased libido (p<0.001), and vaginal dryness (p=0.06). Among postmenopausal Chinese women, there was a significant relationship between perceived stress scores, measured by PSS-10, and the number of menopausal symptoms across five symptom groups. Specifically, higher PSS scores were associated with a greater presence of psychological symptoms (r=0.406, p<0.01), and to a lesser degree musculoskeletal and gastrointestinal (r=0.180, p<0.01), non-specific somatic complaints (r=0.231, p<0.01), respiratory (r=0.180, p<0.01), and vasomotor symptoms (r=0.235, p<0.01) (Yu & Ho, 2010). In contrast, findings from the Seattle Midlife Women’s Health Study suggested that perceived stress was not significantly associated to any of the menopausal-related factors, including menopausal transition stages, urinary estrone glucuronide, urinary FSH, hormone use, and hot flushes (Woods et al. 2009).

**Stressors**

In this dissertation, I am interested in the stressors that might influence menopausal women in Nagaland both at the community and household levels.

**Community stressors**

People from the northeastern part of India, including Nagaland, exhibit many diverse traits, including geographic, cultural, and ethnic traits, and are often considered by mainland Indians as foreigners. Nagaland, populated by "Mongoloid phenotypes" (Wouters & Subba, 2013), is one of the few tribal states in India where residents have felt like outsiders for many reasons. First, the nature of colonization in the Naga Hills during the period from 1840-1880 was motivated by the geographic and strategic location of the Naga Hills for greater commercial trade by the British (Barpujari, 1970). Second, the
Naga-Akbar Hydari Accord signed in 1947 between the Naga National Council (NNC), a political organization of the Naga people active from the late 1940s, and the British administration granted Nagaland protected status for 10 years, after which the Nagas could decide whether the agreement would be extended or whether a new agreement was necessary. The NNC interpreted this as attainment of a sovereign state (Moral, 2018). However, post-colonial India claimed Naga territories as part of the Republic of India, which led to the rise of insurgent groups in the Northeast.

Two main factors, political pressures and problems of insurgency, are of interest because, even though their influence may be subtle, they have a persuasive influence on the lives of the people in Nagaland because of the history of armed conflicts and political instabilities. For instance, the NNC formed the National Socialist Council of Nagalim (NSCN) in 1980, demanding a greater Nagaland encompassing all Naga-inhabited areas in India's Northeast. Though a cease-fire was agreed to between the Indian government and the insurgency group in 1964, the political settlement of the conflict was not achieved. This led to continued threats to the civilian population that stemmed from divisions within the groups, leading to the formation of multiple insurgent groups, heavy extortions and taxes on the state residents, and constant conflict between different insurgent groups. Even though Nagas are exempt from paying income tax to the Indian government (Directorate of Income tax, 2011), they pay 24% of one month's salary each year to the insurgent group (Parashar, 2017), and multiple taxations by numerous insurgency groups (Sen, 2015; Santoshini, 2016; Dey, 2018) have burdened the people with fear and anguish. Furthermore, multiple shooting incidents (e.g., “Three injured”,
linked to the insurgent groups are common, disrupting and compromising people's ability to go about their daily lives.

The political situation in India has also divided people with different degrees of opinions. The Citizen Amendment Act (CAA), passed in 2019 has divided the country, with certain groups of people opposing the Act and others vouching for it. The CAA offers citizenship to non-Muslims fleeing religious persecution from three nearby countries - Pakistan, Bangladesh, and Afghanistan. Though the majority of Northeast states (including Nagaland) have strongly voiced their opinion against the Act, the representatives of various states, including Nagaland, have supported the Act (“Anti-Citizenship Amendment”, 2019; Hasnat, 2020). This has resulted in various protests across Nagaland (Ameen, 2020; Parashar, 2020; “Countrywide protests”, 2019), leading to disruption in the normal lives of the people protesting against the amended Citizenship Act (Beniwal, 2019). Similarly, other tense situations have been occurring in Nagaland over the past decade. For instance, the quota system reserving 33% of municipal seats for women in Nagaland imposed by the Indian government was not accepted by the locals. This led to violent protests and rallies (Rutsa, 2017; Solomon, 2017). Thus, political conflict has ramifications, leading to stress within the community.

Currently, the Naga insurgency, India's longest insurgency (Chasie & Hazarika, 2009:54), coupled with the ongoing political climate in India and racial discrimination (Wouters & Subba, 2013), have been obstacles to political, economic, and social development in Nagaland (Ganguly & Findler, 2009). As a result, these events have led to insecurity and stress within the Naga community (e.g., Zagefka & Jamir, 2015). Similar studies from around the world have also found negative and long-term
pathological effects and mental health problems associated with exposure to political violence and conflict (Bleich et al. 2003; Bryce et al. 1989; Clukay et al. 2019; Mollica et al. 1993; Scholte et al. 2004; Sievert & Obermeyer, 2012; Panter-Brick et al., 2018; Pedersen, 2002). Therefore, in the context of the political instabilities and armed conflicts in Nagaland, I am interested in understanding how women experience menopausal symptoms while dealing with the aforementioned stressors.

**Household stressors**

Household stress or family stress can be defined as “any stressor that concerns one or more members of the family (or the whole system) at a defined time, which impacts the emotional connection between family members, their mood, well-being, as well as the maintenance of the family relationship” (Randall & Bodenmann, 2013). Midlife women experience not only physiological manifestations of the menopausal transition but also experience transformations in their social roles, such as assuming the role of a grandmother, taking care of aged parents, and undergoing various life events such as the marriage of their adult children, loss of a loved one, and separation, which can induce significant stress and adversely affect their well-being. For instance, a study conducted in Perth, Western Australia, exploring how contemporary women experience midlife transitions, both physiological and psychological, reported that while most women manage the transitions of menopause relatively well, the impact of divorce and the aging and death of parents present more serious long-lasting challenges to women (Dare, 2011). More interestingly, a qualitative research study exploring the divorce transition experiences of 24 divorced women who identified themselves as belonging to one of the three decision-making groups: initiators, non-instigator, and mutual deciders
reported that instigators experienced a divorce transition characterized by self-focused growth, optimism, and social support losses and opportunities whereas non-initiators reported a transition that involved being left, ruminating, vulnerability, and spiritual discomfort. Among mutual deciders, no distinct pattern was reported (Sakraida, 2005).

Within the Naga society, despite the patriarchal social system, the status of women in Nagaland and Naga society has been lauded (Fürer-Haimendorf, 1939:10). Unlike the rigid hierarchical system as seen in Hindu society, the Indian caste system for instance, Naga society lacks such a structured system. Thus, as observed in several tribal and indigenous communities in Northeast India, women in Naga society enjoy rights in all matters of social, cultural, and religious matters (Shimray, 2002). However, even though Naga women have a lot of freedom, and are not systematically suppressed by men (or at least it is not evident at first glance), freedom does not necessarily equate to having rights in many aspects of Naga society. For instance, when it comes to property rights, a father will only bequeath his ancestral land to his son, and never to his daughter, and this has been voiced as a complaint by many women in Nagaland (e.g., Gill, 2005).

Despite the relative equality of women in Naga society, they still face stressors that can have adverse effects on their well-being. Many Naga women are responsible for a range of household duties, including childcare, cooking, cleaning, and other domestic work, which can lead to significant stress and burnout. Moreover, women going through the menopausal transition may face additional challenges in balancing these responsibilities and further exacerbating the stress they experience. Thus, assessing specific household stressors, in this regard, is significant to help researchers and healthcare professionals develop targeted interventions. Moreover, as household stressors
vary across cultures and contexts, studying household stressors in a particular cultural context can inform important and unique stressors that women may face and thus provide culture-sensitive interventions and improve women’s health outcomes.

Within the context of these aforementioned stressors, social support plays a crucial role in helping women cope and navigate these challenges (e.g., Arnot et al. 2021; Ozbay et al 2007). The significance of social support in this study is discussed below.

**Social support**

Social support has been described as “support accessible to an individual through social ties to other individuals, groups, and the larger community” (Lin et al. 1979). Studies have indicated that a sense of community and strong social cohesion can have a positive effect on mental health outcomes in individuals and groups exposed to terror-related stressors (e.g., Moscardino et al. 2010). More broadly, multiple studies indicate positive health outcomes due to the provision of social support (Albrecht & Goldsmith, 2003; Brown et al. 2003; Cohen et al. 2000; Kaplan et al. 1977; Raffaelli et al. 2013). However, this relationship is complex and influenced by various factors. For instance, household membership can establish social ties and link individuals to the greater society and social structure, which can provide instrumental, informational, and emotional support, benefiting the well-being of an individual (Hughes & Waite, 2002; Hartwell & Benson, 2007; Kawachi & Berkman, 2001). Nevertheless, since household relations are governed by certain norms and expectations found in all social relationships, family relations may also have a negative impact on an individual's well-being (Antonucci et al. 2014). For example, a longitudinal study on negative aspects of relationships with children, best friends, and spouses found that although negativity in relationships with
children and friends tended to decrease over time, negativity in relationships with spouses increased (Birditt et al. 2009).

Social support is embedded in a broader concept of social networks - the web of social relationships that surround individuals (Heaney & Israel, 2008:190); and social support is one of the most important outcomes of social relationships. Seminal work on social support by House (1981) suggests that social support can be categorized into four broad categories, namely: (1) Emotional support - the provision of empathy, love, trust, and caring, (2) Instrumental support - the provision of tangible aid and services that directly assist a person in need, (3) Informational support - the provision of advice, suggestions, and information that a person can use to address problems, and (4) Appraisal support - the provision of information that serves as constructive feedback and affirmation. These different types of support are often interconnected and do not represent an independent construct, such that, one type of support can lead to an integration of another type of support, thus making it difficult to study them empirically as separate constructs (Heaney & Israel, 2008). More recently, studies on the dimensions of emotional and instrumental support in both providers and receivers have gained popularity (Malecki & Demaray, 2003; Mathieu et al. 2019; Morelli et al. 2015; Park et al. 2010; Semmer et al. 2008). Another empirical question that emerges is whether or not the intended support is perceived as helpful by the receiver. This perception is important, as a well-intentioned effort to provide support may be regarded as unhelpful by the recipient and may result in negative consequences (Peters-Golden, 1982; Wortman & Lehman, 1985).
Perceived social support refers to how individuals personally interpret a reliable connection to others, such that measures of perceived social support incorporate the perceived availability and adequacy of supportive ties (Barrera, 1986). Studies have demonstrated that perceived support, rather than enacted support – actions that others perform to assist another person (Barrera, 1986) – provides a better buffer for well-being (Lindorff, 2000; Paulsen & Altmaier, 1995). Thus, the perception of a strong support network affects individuals more than enacted support. Cohen and Wills (1985) in their study analyzed the process by which support relates to well-being, identifying perceived support as an effective type of support that relates to overall well-being. The authors developed two models (the buffering model and the main effects model) to address the effects of social support on various outcomes. They viewed the positive association between social support and well-being as an overall beneficial effect of support (main- or direct-effect model) or a process of support protecting people from potentially adverse effects associated with stressful events (buffering model). The main difference between these two models involves how social support is measured. Within the buffering model, the social support measure assesses the perceived availability of interpersonal resources that are responsive to the needs elicited by stressful events. Conversely, the main effect model assesses the support measure through a person's degree of integration in a large social network.

Studies have indicated a significant association between social support and menopausal symptoms (Aloufi & Hassanien, 2022; Bauld & Brown, 2009; Polat et al., 2021). A cross-cultural study conducted in China involving Han Chinese and Mosuo women reported that certain factors related to perceived family support had predictive
effects on symptom severity during the menopausal transition. Specifically, perceived support from family, the number of family members, and family income were found to be significant predictors. Moreover, the authors also proposed that strong social support can assist women in effectively coping with experiences of loss or grief that may arise during this transitional period (Zhang et al., 2016). Another study involving 732 perimenopausal women in China demonstrated a negative association between perceived family support and menopausal symptoms (Zhao et al., 2019). In my study, I explore the interrelationship between social support, stress, and menopausal symptoms to examine whether the buffering model or the direct effects model is at play.

**Biocultural perspectives**

Biocultural theory is an integration of both biological anthropology and social/cultural anthropology. This approach recognizes the dynamic interaction between biological and cultural phenomena, and thus, seeks to integrate biological, sociocultural, and environmental aspects. Hruschka et al. (2005:4) defined the biocultural approach as “a critical and productive dialogue between biological and cultural theories and methods in answering key questions in anthropology.” One way of viewing the biocultural framework is through the application of a theoretical lens to understand how disease and embodiment are integrated (Csordras, 1990, 1994; Scheper-Hughes, 1994). As such, this approach brings together the holism of local and cultural views, an understanding of illness, and the local practices of traditional or biomedical healing (e.g., Krieger, 2005; Lock, 1993). Studying health and healing from a biocultural perspective provides an understanding of both biological and social factors associated with illness and/or disease and allows us to identify variations in symptom experiences. For instance, in medical
anthropology, biocultural research involves integrating how cultures approach health and healing based on gender, class, age, education, and their own traditional experience with illness and healing. In paleoanthropology, the biocultural approach is helpful in understanding how culture can influence biological evolution, and in turn, shapes cultural behavior patterns. For instance, archaeological research at Qesem cave in Israel demonstrated that large game hunting was a regular practice by the late Lower Paleolithic period. The Qesem cut marks on the bones were both more abundant and more randomly oriented than those observed in Middle and Upper Paleolithic cases in the Levant, suggesting that more (skilled and unskilled) individuals were directly involved in cutting meat from the bones at Qesem Cave (Stiner et al. 2009). In human biological studies, the biocultural model is applied to understand the interaction between biological and cultural factors affecting human well-being (Beyene, 1992; Leatherman, 1996, 1998; McElory, 1990; Sievert, 2006). For instance, a cross-sectional study in Senegal on biocultural determinants of overweight and obesity indicated that Senegalese experience health consequences related to lifestyle transition such that the internal migration from rural to urban or suburban areas was found to be associated with a higher urban or suburban prevalence of overweight or obesity and hypertension, and a valorization of stoutness, sedentary behaviors, and higher SES, exposing people to overweight or obesity (Cohen et al. 2019). Another approach where biocultural perspectives are applied is through political-economic relationships. This approach concerns how culture and political economy affects human biology (Goodman & Leatherman, 1998; Leatherman & Goodman, 1997). For instance, a study on the effects of social and economic change among different segments of the rural population in the Southern Andes indicated that
although there were changes in the agrarian society in the District of Nuñoa such as land
reform, monetization, market expansion, and improved transportation, health, and school
systems, yet such changes had little or no effect on the level of poverty and poor health
outcomes (Leatherman, 1994).

In the studies of menopause, a biocultural perspective can inform our
understanding of the complex interplay between biology and culture in shaping women’s
experiences during this life stage. This approach allows us to examine how cultural
beliefs and practices impact women’s perceptions, attitudes, and management of
menopausal symptoms. For instance, the concept of menopause differs in different
populations as evidenced by studies in Yucatan, Mexico (Beyene, 1989), in Japan (Lock,
1993), and in Puebla, Mexico (Sievert, 2006). In Puebla, menopause is conceptualized as
a distinct life event that is intricately connected to, yet distinct from, the aging process,
and women expressed particular worry about menopausal symptoms. In Japan, Lock’s
research suggests that menopause carries an ambiguous connotation. On the other hand,
in Yucatan, menopause and its associated symptoms were not a source of significant
concern or worry (Sievert, 2006).

The biocultural perspectives also shed light on the role of social support, lifestyle
factors, food habits, etc. that might influence midlife symptoms. For instance, a cross-
sectional study in Iran investigating the association between dietary patterns – vegetables
and fruits (VF), mayonnaise, liquid oils, sweets, and desserts (MLDS), and solid fats and
snacks (SFS) – and physical, mental, and genitourinary menopausal symptoms in
postmenopausal women indicated that VF dietary pattern was associated with a reduced
risk of menopausal symptoms, whereas the MLDS and SFS dietary patterns were
associated with an increased risk (Soleymani et al. 2019). A population-based study of Finnish adults indicated that physically active women reported fewer somatic symptoms than women with a sedentary lifestyle (Moilanen et al. 2010). Thus, a biocultural approach can be understood as a feedback system through which the biological and cultural interact; biology allows certain behaviors to exist and in turn, those behaviors influence biological traits.

**Aims and objectives**

Since symbolic meanings and menopausal symptom experiences are highly contextual to the population being studied, the approaches taken by anthropologists and other social scientists to examine menopausal symptoms and experiences are unique and community-specific (Lock, 1994). These approaches require the researcher to take into account the social factors and "local biologies" which are often invisible but nonetheless influence the overall health of an individual (Lock & Kaufert, 2001). Furthermore, menopause is a biocultural event (Beyene, 1986; Melby et al. 2005; Sievert, 2006) and, therefore, the role that one's cultural experiences, mental processes, and body plays in symptom experience should be explored. Hence, *the first objective of my study is to explore symptoms experienced by women in Nagaland.*

This objective is presented in Chapter 3 and aims to document the frequency of symptoms experienced by women at midlife in Nagaland and explore how these symptoms cluster. More specifically, I investigate the factors associated with subjectively measured VMS and objectively measured VMS, and whether community-specific diet (e.g., soy and spice consumption) influences VMS in my population.
My second aim, as described in Chapter 4, is to investigate the relationship between stress markers measured by fingernail cortisol, blood pressure, and perceived stress and community and household stress and symptom experience at midlife. Because of the unique political and economic issues of Nagaland, my second objective is to investigate the relationship between markers of stress (fingernail cortisol, blood pressure, and perceived stress) and community and household stressors and symptoms experienced at midlife.

My final aim is to investigate the interrelationship between social support, stress, and symptom experience at midlife (Chapter 5). Here, I use the buffering model as the measures used in this model more specifically relate to the perceived availability of community/household support as it pertains to midlife women. In this study, I test whether social support buffers the association between stress and symptoms at midlife.

Significance of the study

Despite extensive research on menopause in India, little is known about the personal meaning or perception of the menopausal transition as experienced by Naga women. During menopause, women report symptoms that may directly or indirectly relate to menopause, and these symptoms can range from mild to severe. For instance, in Turkey, some women report symptoms of migraine headaches like nausea, vomiting, and sensitivity to light and noise (Karli et al. 2012), and in Japan and the US, fatigue including lack of energy, mood changes, and dizziness related directly or indirectly to menopause (Terauchi et al. 2013; Greenblum et al. 2013). Additionally, in the US, women have reported disturbances in day-to-day activities because of flushing and perspiration, sleep disturbances, irritability, and anxiety (Handley & Williams, 2015).
Since menopausal symptoms are subjective and related to factors such as ethnicity and culture, my study will examine the most frequent/bothersome symptoms experienced by women in a demographic that has been previously unexplored in prior research. Furthermore, the findings of this study may have implications beyond the specific population of women in Nagaland. The multi-level stressors that were examined (household stressors and ethnopolitical problems) although unique to Nagaland, can be prevalent in varying degrees in other populations with similar sociocultural contexts. Therefore, results from this study may provide valuable insights for understanding the impact of these stressors on menopausal symptoms in other populations facing similar challenges. My study will also add to the existing literature on variations in human menopausal experiences and shed light on "norms" based on the symptoms experienced.

Common psychological changes that occur during the menopausal transition include mood disturbances, irritability, difficulty in concentration, anxiety and depression, and loss of interest in most things (Greene, 1976). The Penn Ovarian Aging cohort study showed that women undergoing the menopausal transition have a 3-fold risk of developing depression compared to pre-menopausal women (Freeman et al. 2006), but the changes are transitory, and the risk of depression decreases after menopause (Freeman et al. 2004). Another study in the US among women with naturally occurring menopause showed an increase in the frequency of depressive symptoms during perimenopause (Maartens et al. 2002). In this study, I will examine levels of depression associated with menopausal symptoms and identify the most salient symptoms before, during, and after the menopausal transition. Moreover, I will document these associations in the context of the Naga community.
Finally, menopause-related changes in levels of estrogen result in an increased risk of obesity. Weight gain can be related to symptoms such as aches and pains and hot flashes. For instance, during postmenopause, obese women were more likely to report moderate/severe vasomotor symptoms, specifically hot flushes or flashes and sweating (Koo et al. 2017). This research aims to evaluate the occurrence of hot flashes recorded by the Biolog monitor and will help assess whether women in the Naga community, who tend to have lower BMIs, experience higher or lower levels of hot flashes. This will be the first study to apply the ambulatory Biolog monitors in northeast India. Additionally, this study will contribute to the existing literature on stress, social support, and symptoms at midlife. By examining the associations of stress, social support, and symptoms at midlife in a population with unique multi-level stressors, this study contributes to the existing literature on menopause research. The knowledge gained from this study may serve as a baseline for future research in other populations experiencing similar multi-level stressors, thereby providing a comprehensive understanding of the impact of stress on menopausal symptoms and inform the development of tailored interventions to support women's well-being during the menopausal transition. To the best of my knowledge, this is the first study documenting the association of chronic stress, as measured by fingernail cortisol, and symptoms at midlife.
CHAPTER 2

METHODS

This chapter provides an in-depth description of the study area, incorporating geographical, cultural, and socio-economic structures. It describes the system of governance, including the political institutions, local administrative units, and their respective roles and responsibilities. As religion plays an important role in shaping the beliefs, values, and cultural practices of the Naga community, this chapter also discusses the religious composition within the study area, exploring the dominant faiths and religious institutions. A brief description of the household structures and social organization is also described to understand the gender relations and distribution of resources and authority within the community. Finally, this chapter outlines the methodologies and procedures employed in gathering data in Nagaland, India, addressing the ethical considerations and challenges encountered during the data collection.

Study area and the people

The study was conducted in Nagaland in the cities of Kohima and Dimapur, and the villages of Mima and Shaki. Nagaland is one of the smaller states in India and is located at 26.1584° N latitude and 94.5624° E longitude. It shares its boundaries with the Indian states of Arunachal Pradesh to the northeast, Manipur to the south, and Assam to the west and northwest, and an international boundary with the country of Myanmar to the east (Barthakur & Lodrick, 2019). The state capital is Kohima, located in the southern part of Nagaland. Nagaland consists of 16 districts with a population of 1.9 million and an area of 6401 sq miles. About 29% of the people live in urban areas (Census, 2011). The state is mostly mountainous and merges with the Patkai Range, part of the Arakan
system – a mountain range in western Myanmar, reaching a maximum height of 12,552 feet above sea level at Mount Saramati. Nagaland has a monsoonal climate with annual rainfall between 70 and 100 inches during the months of May to September. Average temperatures decrease with elevation, such that, in the summer months, temperatures range from the 70s °F to the 100s °F with high humidity, while in the winter they rarely drop below 40°F (Barthakur & Lodrick, 2019).

Nagas are Indo-Asiatic people consisting of more than 20 tribes and subtribes specific to their geographic region spreading across the Indian states of Nagaland, Manipur, Arunachal Pradesh, and some parts of Assam and the country of Myanmar. However, unlike other Indian states or the country Myanmar, Nagaland is inhabited entirely by the Nagas. The main tribes in Nagaland consist of Ao, Angami, Chakhesang, Chang, Khiemnungam, Konyak, Kuki, Lotha, Phom, Pochury, Rengma, Sangtam, Sema, Tangkhul, Yimchungre, and Zeliang. There are about 60 spoken dialects, all belonging to the Sino-Tibetan language family. The tribes lack a common language, and, in some areas, dialects can vary even from village to village. Intertribal conversations are carried out generally through Nagamese Creole, an Assamese-lexed Creole language, and with outsiders through Hindi or English (Census, 2011). Agriculture accounts for a major part of the state's economy. As such, 60% of the population is engaged in the agriculture sector, given the climatic conditions which favor agriculture, horticulture, and forestry (IBEF, 2020).
Figure 3: Map of Nagaland, (Source: https://www.bragitoff.com/2016/04/high-resolution-map-nagaland-hd/ and https://www.nationsonline.org/maps/India-States-Map.jpg)
Nagaland is generally a rural state, with Kohima and Dimapur as its urban centers. Kohima, a hilly district with a total population of 267,988 (121,088 people living in urban areas), has a pleasant and moderate climate that is neither too cold in winters nor too hot in summers with an average elevation of 4137 feet above sea level (Census, 2011). Kohima has deep historical roots as one of the oldest districts among the fifteen districts of the state and a battleground during World War II. As the state capital, Kohima is the administrative and political center. The district consists of four Rural Development Blocks (RD blocks) namely, Kohima, Chiephobozou, Jakhama, and Tseminyu. As such, data were collected from the Kohima block (highlighted in Figure 3) because this block, generally considered urban, consists of a heterogeneous tribal population with people from different tribes of Nagaland as well as people from other Indian states.

Dimapur became the eighth district of the State in 1997, and is one of the most populous districts, with a population of 378,811, where about 122,834 live in the urban areas (Census, 2011). Although Nagaland is mostly mountainous, a large area of the Dimapur district is in the plains with an average elevation of 853.02 feet above sea level except for the Medziphema sub-division and a few villages of the Niuland sub-division, which are located in the foothills (Census, 2011). The climate in Dimapur district is hot and humid, reaching a maximum of 96.8 °F during the summer months, with humidity of up to 93%, and an average annual rainfall of 59.24 inches (Census, 2011). Dimapur consists of 6 RD blocks namely, Niuland, Aquqhnaqua, Nihokhu, Chumukedima, Dhansiripar, and Medziphema (District Administration Dimapur, 2021), and is well connected to other Indian states through roadways, airways, and railways, and is the only city in Nagaland to be connected by rail and air to other parts of India. As such, it is the
main center of commercial business and exchange and is one of the fastest developing regions of Northeast India. With fast economic development and a center for commercial exchange, there is a sizable population of non-tribal residents from other Indian states living in the town areas. Therefore, the district has a heterogeneous population with the majority comprising Naga tribes from all over Nagaland.

Figure 4: Views of Kohima (a &b) and Dimapur (c).

Mima village falls under the Kohima district and is mostly inhabited by the Angami Naga. It is located about 11 miles from the state capital Kohima (Census, 2011). With a population of about 2,419 people (Census, 2011), the village is known for its traditional practices of beekeeping. Apiculture is one of the primary forms of occupation for people living in the village. Agriculture, mainly rice cultivation, is also widely
practiced by most members of the community. As the process of rice cultivation differs from other grains because it is a semi-aquatic plant that requires consistent irrigation all season to grow, the timing of rice planting depends heavily on the monsoon season. As such, the terrace cultivation technique, a form of cultivation where “steps” known as terraces are built onto the slopes of hills and mountains mainly for water retention, is commonly practiced. In this form of cultivation, huge manpower is needed for different steps such as tilling the soil, making terraces for proper irrigation, planting rice saplings, and harvesting. In all these steps, women are equally or sometimes even more involved than men.

Figure 5: Views of Mima village

Shaki village, located in the Wokha district of Nagaland, is primarily inhabited by the Lotha Nagas. The village consists of about 339 households and a population of about 1918 individuals (Census, 2011). Like Mima village, people from Shaki village also engage in agricultural activities; however, they practice jhum cultivation – a form of cultivation where plots of land are cultivated temporarily. This form of cultivation is quite common among many tribal populations in Northeast India. Unlike terrace cultivation, jhum cultivation involves a tremendous amount of work throughout the year. First, the selected land is cleared of vegetation during the months of January or February and the vegetation is left to dry followed by burning of the dried vegetation during
March. After the process of burning, the land is tilled, and the remaining weeds or grass are cleared. Dibbling – placing seeds in holes made in seedbeds and covering them – usually occurs during the month of May or June. The process of dibbling can be tedious as the soil has to be prepared again and seeds need to be planted. Weeding is another tedious process that is carried out at least twice, depending on the number of weeds. Finally, crops are harvested in the month of October. The most labor-intensive process (dibbing for instance) is generally accomplished with the help of other members of the community, and women are typically involved in all major activities in this process.

Figure 6: Views of Shaki village.

**Political and administrative organization**

The State Government of Nagaland is the governing authority of Nagaland, which is led by a Council of Ministers or members of the Legislative Assembly (MLA). The MLA consists of 60 members headed by a chief minister. Nagaland’s Legislative Assembly is a unicameral legislature, and all members are elected by voters of an electoral constituency or district. Overall, the constitutional head of state is the governor, appointed by the president of India. The Council of Ministers are elected once every 5 years, and elected candidates have no direct term limits, which means that the same candidate can be re-elected continuously if he/she maintains support from the
people/voters. The political and administrative setup of the state is closely tied together. For instance, they work jointly in avenues like state general elections.

The administrative responsibility of each district falls under the deputy commissioner (DC) such that each district has a deputy commissioner to foresee the administrative responsibilities. Further, districts may be divided into sub-divisions, each of which has an additional deputy commissioner (ADC) responsible for administrative purposes. A larger sub-division may also require several sub-divisional officers (SDO) or Extra Assistant Commissioners (EAC) to discern administrative responsibilities within that sub-division. In urban areas like Kohima and Dimapur, the deputy commissioner along with its council of administrative members (SDOs, EACs) foresees administrative responsibilities in different RD blocks. In addition, these RD blocks are further divided into smaller administrative blocks called colonies. Most colonies are generally headed by a chairman. Besides the chairman, every colony has other members, like the vice president, the general secretary, and the youth president, among others, to help allocate resources within their own colony, highlight the needs of the colony, and procure grants or resources from the government. All activities are jointly discussed among the members of the board who generally vote on the decisions of the majority. However, disagreement can often arise among the members due to many reasons (for instance, mismanagement of resources).

The administrative setup, at the village level, is also quite complex and is based on the Nagaland Village and Area Council Act, 1978 (Nagaland Gazette, 1979). This act dictates and provides a structural baseline for a Naga village administrative setup. As such, every village, irrespective of size, has a Village Council. The Village Council
members are elected or chosen from amongst the village members as per the prevailing customary practices and usages. In most instances, every Khel (section of the village) and clan are given fair representation in the Village Council by allowing the Khel or clan to nominate or elect its representatives in the Council. The size of the Village Council depends on the size of the village but, in general, the Village Council consists of members composed of representatives from each clan, a woman representative, and a youth representative. These representatives are usually elected for 5 years, after which new members are elected in the village council by notifying the district’s DC. In addition, villages also have a Village Development Board (VDB), preferably having representatives from each clan. The Village Council and the VDB work closely for the development of the village. Development funds from the State Government for the village are in the form of infrastructure development (inter-village road construction, water supply schemes, etc.). The VDB executes these schemes with labor drawn almost entirely from the village without outside help. The tenure for members of the VDB is generally 3 years. Furthermore, within the village, there is also the Village Council Judiciary Committee board which exercises power over smaller legal and judicial matters, but major cases are referred to the Dobashis (an intermediary between the people and the state government) who respond to the judicial court of SDOs or DCs. Gaonburas, who are the members of the village council, perform important functions and are directly involved with the administration of the village. Usually, gaonburas are permanent representatives and they are either elected from amongst the villagers or nominated by them. The Village Council, gaonbura(s), and dobashi(s) work in coordination with the villagers in all development activities of the village. These board members usually
consist of male members of the village. In general, we see few women representation in decision-making bodies, especially at the village level.

Religion

Nagaland is generally considered a Christian state with 88% of the population identifying as Christians. Also known for its megachurches, Nagaland is also home to Asia’s largest church (Sumi Baptist Church, Zunheboto) standing at 166 feet in height. Religion plays an important role in the lives of Nagas. Although Christianity is the most popular religion in Nagaland, in urban areas like Kohima and Dimapur, religion is more diverse. Other dominant religions in mainland India such as Hinduism and Islam are also present but are negligible with only 8.6% and 2.5% of the population following Hinduism and Islam respectively (Census, 2011). On the other hand, villages are considered more homogenous in terms of religion. For instance, Shaki village follows the Baptist faith except for one family who follows the Catholic faith while Mima village has more diverse Christians consisting of Roman Catholics, Baptists, and Revivals.

The general setup of the church is typical, consisting of the pastor, assistant pastor, women leader, deacons and deaconess, ushers, and caretakers, although more members can be selected based on the need. For instance, Shaki Baptist will be celebrating 100 years of following the Baptist faith in 2029, and in lieu of that, they have elected different members to help assist in organizing the event. A typical tradition that members of all Christian churches in Nagaland follow is donating 10% of their monthly earnings (monetary or otherwise) to the church. This is referred to as “ten tithes”. A person would usually donate his/her tithes to a church to which their name is affiliated. One can become affiliated with a church by baptism, a symbolistic ritual for admission to
a church, or by transferring their certificate of baptism from another church. However, there are no stringent rules on donating the tithe. People can donate to other churches or organizations relating to any religious activities. These donations are used by the church to pay wages to members of the church (e.g., Pastor, evangelist), or used to help organize activities related to the church. Others who do not earn any monetary income donate part of their agricultural harvest to the church. However, there are minor variations in activities among churches and villages. For instance, every household in Shaki village saves a handful of rice in a separate container every meal (morning and evening) to be collected at the end of the month for use by the church, and usually, women take this role of collecting the grains, door to door. However, this activity was not recorded in Mima village or the urban areas.

Women take an active part in many activities related to the church. For instance, women take up specific roles such as women leaders (in the church) or deaconesses. The role of a church women leader is similar to the role of a church pastor but centralized towards women. Besides the usual morning church service on Sundays, women congregate once every week (Thursday evening for instance) for fellowship. This female-only fellowship is common in both rural and urban areas. In addition, other smaller women’s groups, related to religious activities, are common in urban areas (women’s prayer fellowship, for instance). Most churches and religious fellowships in Nagaland are carried out in a local dialect (Tenyidie, Ao, Sema, etc.), and thus one would, usually, attend a church based on his/her tribe. Some churches use Nagamese (e.g., Nagabazar Nagamese Church) or English (e.g., Faith Harvest Church) as a medium of
communication. Thus, in churches like these, we witness a heterogeneous type of tribal community.

**Naga household**

Another avenue where women play a central role is the household. Women, in general, invest a substantial amount of their energy in their households. This is the same for most Nagas. Naga women are highly invested in caring for other members of the household including spouses, children, parents (both in-laws and her own), or grandchildren, running the household, and in many instances helping to procure resources to maintain the household through agricultural activities or working in private/public sectors. Another prevalent practice observed in the Naga community is the utilization of child and adult labor for household tasks. It is common practice to recruit children or adults from nearby villages or neighboring states like Assam and Arunachal Pradesh. These individuals are engaged in various household chores and in return, the household owners provide them with education or monetary compensation. Often women’s roles are taken for granted or undervalued. The role of a woman in a household can differ from household to household but a greater difference is observed among rural and urban counterparts. To better illustrate this difference, the lives of two women (one rural and one urban) are depicted below. The daily activity patterns of the woman residing in rural area were documented through direct observation and narrative-based interviews, while for the woman living in urban area, the information was obtained solely through narrative-based interviews.
Mhalo, a 43-year-old woman living in a rural village, is a mother to four children. Her four children live in a nearby town where they pursue education and job opportunities. Her formal education is limited, having completed only up to the second grade. She explained that her academic struggles during her early years compelled her to discontinue schooling and instead help her parents with agricultural activities. She grew up with six siblings and got married at the early age of 18. Her spouse, four years older than her, also works as a farmer. Like many women in her village, her daily routine begins with her waking up at around 4:00 am. Being the first to awaken, she proceeds to prepare meals and feed the domesticated animals, including chickens, dogs, and pigs. After her own breakfast, which includes rice and vegetable curry, she packs the remaining meal with the help of banana leaves to take it to the field. By 5:30 am she loads her food and equipment (e.g., machete, plow) in a bag or a bamboo basket and walks to her field which is about three miles from the village, accompanied by her spouse. This 3-mile route can be quite difficult due to the hilly and uneven terrain. She then settles down in her little makeshift hut which is usually built at the beginning of the year, starts a fire, and begins boiling the kettle with water drawn from the stream nearby. While her husband starts working in the field, she makes tea and delivers it to him. They both enjoy their cup of tea with some biscuits. Following this brief respite, she starts plowing the land and sowing seeds for the year. This continues until noon. Around noon she starts up the fire again, prepares another round of tea, and shares a meal of packed rice and curry with her husband. After this meal, they continue planting seeds up until about 3 pm, after which they gather plants and shrubs nearby that constitute feed for the

---

5 Name has been changed.
pigs. By 4:00 or 4:30 pm, they make their way back to the village. After returning from the field, she starts preparing for supper. The husband, on the other hand, assists in collecting water from the nearby water tank which operates on a schedule (5:00 am to 7:00 am and 5:00 pm to 7:00 pm). After supper, the husband usually has a visitor or visits fellow members of the community, while she takes care of the remaining chores at home.

Azi\(^6\), a housewife, aged 46, lives in Kohima with her three children and spouse. Her husband, a successful bureaucrat, is the sole provider for the family. As a housewife, she is responsible for managing the household, undertaking various responsibilities to ensure its smooth functioning. Her daily schedule commences at 7 am to prepare meals for the family and attend to the completion of the household chores, which makes up a significant portion of her time. Her chores include cleaning the house, doing the dishes, washing clothes, and going to the market to purchase groceries. She often spends time with her neighbor-friend who is also a housewife. Unlike agricultural labor, the household chores she undertakes are not labor-intensive, allowing her to have more leisure time compared to her counterparts residing in rural areas. In addition to her household chores, Azi\(^6\) harbors other household responsibilities including the well-being and needs of all family members, financial planning, and child-rearing, among others. Despite not being the breadwinner, she assumes control over household finances. In general, women living in urban areas are involved in less labor-intensive activities, unless they engage in farming-related endeavors. Consequently, they enjoy relatively more leisure time in their routines.

---
\(^6\) Name has been changed.
Data collection

Cross-sectional data were collected from 151 women aged 45-55 years from the four field sites. The following were exclusion criteria: non-tribal populations, pregnant/lactating women, those who underwent hysterectomies, and those using hormone therapy. With the help of the key informants, interested participants were recruited for the study. Before the start of data collection, participants were informed about the study procedures, and a consent document was signed by each participant. Data from Kohima were collected at different intervals. This is because the rising cases of COVID-19 in India and Nagaland, from March to June 2021, restricted vehicular and individual movement due to state-issued multiple lockdowns. All interviews and data collection were carried out by adhering to all community-specific COVID-19 norms and regulations. During the entire duration of the data collection, no participants reported any COVID-19 symptoms nor were diagnosed with the disease. All participants were recruited with the help of a key informant, a well-connected person (in terms of social connections) located in the same geographic vicinity as the participants. These key informants were recruited based on my social connections and/or by contacting the respective authorities. For instance, in Mima village, through my social connections with the village chairman, the chairman identified a woman informant who agreed to act as the key informant. Furthermore, a special permit was also sought from the EAC Chumukedima Town for vehicular and individual movement as the lockdown was imposed from 4:00 pm to 6:00 am daily with odd and even vehicular number movement in lieu of the statewide COVID-19 restrictions.
With the rising cases of COVID-19, main centers like Kohima and Dimapur were imposing strict guidelines, and thus, recruiting participants from these areas was slow and challenging. This forced me to expand my study field site to neighboring areas or villages where the cases of COVID-19 were lower. Therefore, after talking to the local authorities in the area (Mima and Shaki villages) and with a negative COVID-19 test at hand, I traveled to Mima and Shaki villages to continue recruiting participants for the study. Verbal consent was sought from each village chairman (community leader of the village) to conduct research in their village.

My stay in Mima village was during the monsoon season (end of May and beginning of June 2021), which coincided with the step of making terraces, and thus recruiting participants was difficult during the weekdays. Nonetheless, on weekdays, I recruited those participants who did not engage in agricultural activities and the remaining participants on weekends. Weekends, especially Sundays, were peak days for recruiting participants in both villages. Participants from Mima village were also recruited based on opportunity sampling. For instance, during my stay in Mima village, one of the village elders passed away and, since it is customary for the whole village to pay homage to the deceased family, I was able to recruit more participants that day (after the funeral service) as compared to other weekdays. Similarly, my stay in Shaki village was mostly during the month of June 2021 and thus coincided with the process of dibbling, making it harder to recruit participants during the day.

All interviews were conducted in Nagamese, or tribal dialects based on my level of proficiency. In instances of a communication gap, the key informant served as the translator. Interviews were recorded with the help of an audio recorder. A total of 149
women consented to an audio recording. Women were queried about general demographic and health information such as age, tribe, marital status, size of the family, education, age at menarche, and age at menopause. Anthropometric measures of height and weight were collected. Height was recorded in centimeters with the help of an anthropometer and weight by an analog scale in kilograms. Community-specific questions, such as monthly per capita income from all sources within the household, education, employment of a domestic helper, type of housing, type of locality, and number of children were queried to assess the socio-economic status of each individual. Additionally, objective hot flashes were recorded with the help of a Biolog monitor (UFI, Morro Bay, CA). Participants were asked to wear the two silver/silver chloride electrodes on either side of the sternum, with a 0.5 constant voltage circuit, for 24 hours and press the event marker when they felt a hot flash occurring during the study period (Sievert, 2013).

Additionally, a standardized questionnaire for menopausal symptoms (Greene Climacteric Scale: GCS, Greene, 1976) was administered to understand how symptoms vary among individuals within the population, and how they compare globally. After administrating the GCS, participants were asked whether they were bothered by any other symptoms besides those listed in the GCS and asked to rate all symptoms on a scale of 0 (not at all); 1 (a little bit); 2 (quite a bit); and 3 (extremely).

Questions about diet with a focus on foods and spices that may impact the experience of hot flashes were queried. For example, women were asked to report their intake of foods high in phytoestrogens, such as soy products and spices (Naga Morich or Raja Mircha). Soy is consumed by the Nagas mostly in the form of a fermented paste
called *Axone*. Although *Axone* is consumed by all tribes in Nagaland, it is known as one of the delicacies among the Sumi tribe. *Raja Mircha* on the other hand is a spicy chili pepper cultivated mainly in Northeast India and Bangladesh. This spice is a major part of the diet among the Nagas. Mathur et al. (2000) reported the *Naga Morich/ Naga Jolokia* to be a variety of *Capsicum frutescens L*, that is about 855,000 Scoville Heat Units (SHUs).

To assess the level of depressed mood, participants were asked to answer questions about depression using the Beck's Depression Inventory (BDI, Beck et al. 1996), which has been validated for use in the Indian population (Basker et al. 2007; Kumar et al. 2012; Unnikrishnan et al. 2012). The BDI consists of a 21-item scale with a Likert score from 0 to 3. Additionally, the total score was summed and categorized into 6 categories: 1-10 = Ups and downs considered normal, 11-16 = Mild mood disturbances, 17-20 = Borderline depression, 21-30 = Moderate depression, 31-40 = Severe depression, and over 40 = Extreme depression (Beck et al. 1996).

Factors potentially related to stress were also queried. For example, I asked questions about racial discrimination such as, “have you ever felt that you were discriminated against based on your religion, color, or ethnicity? Have you or your family ever experienced racial discrimination while visiting/living outside the state? Are your worries about your child’s well-being impacting your health in any way?” Additionally, questions about political conflict and insurgency were queried to understand how women in Nagaland feel about these problems and to find out whether or not these problems impact their daily lives. For instance, open-ended questions included, to what extent were you or your family members affected by the problems of insurgency? Are the taxes levied
by the factions a burden to your family? Were you or your family members injured due to the violence caused by the political conflicts in Nagaland (e.g., State election, Citizen Amendment Act, 30% quota, etc.)?

Furthermore, biomarkers of stress were collected. Blood pressure was measured with the help of an aneroid sphygmomanometer and stethoscope. Fingernail samples for cortisol were collected from every digit by clipping directly into a Ziploc® bag or onto a large sheet of paper to avoid losing any parts of the sample. The 10-item Perceived Stress Scale (PSS-10) was also administered to collect data on perceived stress (Cohen et al. 1994). The PSS measures the degree to which situations in one’s life are considered stressful during the past month. For instance, I asked participants how often they felt nervous and stressed. And how often did they feel that things were not going their way? Each question was answered on a Likert scale ranging from 0 to 4, with higher final scores indicating higher perceived stress.

Lastly, participants were queried on perceived social support using the Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al. 1988) in addition to open-ended questions about social support. The MSPSS is a brief 12-item, self-administered measurement tool and includes statements such as, there is a special person who is around when I am in need, my friends try to help me, and my family is willing to help me make decisions. These statements were divided into three subscales based on four statements each for family, friends, and significant others with answers on a seven-point Likert scale ranging from 1 (very strongly disagree) to 7 (very strongly agree). A higher score indicated greater perceived social support. The scale has been validated and used in the Indian population as well (Kwan et al. 2016; Mahalakshmy et
al. 2011). Open-ended questions on social support included various aspects of financial dependency, the experience of violence (emotional/physical) caused by their spouse, and support through religious affiliation to understand whether religious affiliation acts as a support system or imposes stress on the individual.

Figure 7: (a) participants wearing Biolog monitors; (b) blood pressure reading.

**Data collection procedures**

**Height:**

Standing height was measured using an anthropometer rod. The participants were asked to stand barefoot on a flat surface/floor with both feet placed together and their backs against a vertical wall. Additionally, they were asked to stand straight with their palms facing towards their body and the head positioned at the Frankfurt horizontal plane (an imaginary plane connecting the highest point of the opening of the external auditory canal with the lowest point on the lower margin of the orbit). The anthropometer rod was
placed on the right side of the participant and, with the help of the sliding scale, the caliper was placed on the vertex (highest point on the head) and measurement was taken from the floor to the vertex. In instances where a vertical wall was not accessible, the anthropometer rod was placed at the back of the participants. In all cases, the readings were recorded in centimeters.

**Bodyweight:**

Participants were asked to step on a weighing scale barefoot with minimum clothing and were asked to stand upright with their heads facing forward. The readings were then recorded in kilograms.

**Waist circumference:**

Waist circumference was measured with the help of an inelastic tape and recorded in centimeters. The measurements were taken by wrapping the tape around the waistband which usually falls between the ilium and the last rib. In most instances, participants were asked to locate their waists. This was also more comfortable for the participants as locating the ilium and the last rib was difficult for participants with higher subcutaneous fat along the waistline.

**Hip circumference:**

The hip circumference was also measured using inelastic tape. The widest part of the participant’s hip was located, and with the help of the inelastic tape, the readings were recorded in centimeters.

**Systolic and diastolic blood pressure:**

Resting blood pressure was measured using an aneroid sphygmomanometer and stethoscope. The participants were asked to sit comfortably on a chair with the left hand
resting on a table or the arm of the chair at heart level and in a way that the hand makes an obtuse angle (greater than 90 degrees) at the elbow and the palm facing upwards. The sleeve on the arm was rolled up and any tight-sleeved clothing was removed. Participants were also asked to sit up straight with their backs against the chair and legs uncrossed. The brachial artery pulse was located with the help of the tip of the index, middle, and ring fingers. Then, the cuff of the sphygmomanometer was wrapped around the upper arm about 1 inch above the bend of the elbow and the dial (mercury gauge) was placed on top of the cuff. Simultaneously, the stethoscope head was placed over the brachial artery, and with the help of the pressure gauge, the cuff was inflated up to 50 points (mm Hg) above the expected systolic pressure. While viewing the readings on the gauge and listening for Korotkoff sounds (audible sounds used to measure blood pressure), the pressure was slowly released in the cuff by opening the airflow valve counterclockwise. Finally, the first pulse beat and the last pulse beat were recorded as the systolic and diastolic blood pressure, respectively.

_Fingernail samples:_

Participants were asked to clip their nails with the help of a nail clipper directly into a Ziploc bag or on a piece of white paper to ensure that no clippings were lost. Participants whose nails were not long enough to be clipped during the time of the interview were given a Ziploc bag and asked to clip the nails after 3 weeks or more depending on the growth of their nails. For all participants, the date of clippings was recorded along with the date of the interview. A few participants who were farmers or engaged in some forms of agricultural activity were unable to provide fingernail samples as their nails were brittle and chipped off due to constant wear and tear caused by their
occupation. Additionally, participants were also queried about steroid use (oral, injectables, nasal spray, or ointment) and nail polish use.

Each Ziploc bag containing an individual sample was labeled by the participant’s ID and stored at room temperature away from direct sunlight. The fingernail samples were transported via airplane and then subsequently to Dr. Jerrold Meyer’s laboratory in the Department of Psychological and Brain Sciences at the University of Massachusetts Amherst. The fingernail samples were analyzed for Fingernail cortisol (CORT, pg/mg) using the Arbor Assays (Ann Arbor, MI) DetectX enzyme immunoassay kit (#K003–H1) employing the following procedures. First, each fingernail sample was weighed and placed into a 2.0-ml microcentrifuge tube, an ideal sample should weigh about 20-50 mg and no more than 60 mg. This is because the cortisol value can be out of range or undetectable. All samples for this study were within the ideal range. The next step was washing each sample twice, for 1 min with 1 ml of isopropanol to eliminate external contamination. Working with one sample at a time, the sample was vortexed intermittently for 1 min. Following washing twice, the nails were air-dried for at least 24 hours. After drying, fingernails were grounded for 2 min (with 2-3 min intervals in between) using a Mini- BeadBeater-16 (BioSpec, Bartlesville, OK) with a single 6.35 mm chrome steel bead. The interval in between is to avoid the sample labels from melting as they are non-heat resistant. Ground nails were then put into a clean 2.0-ml tube with 1.5 ml methanol and vortexed for 2-3 seconds. After which, the samples were rotated overnight for 18–24 hrs. and the suspended particles were extracted overnight. The evaporated extract (1 ml) was transferred into clean ID labeled 1.5 ml Eppendorf tubes and placed in the SpeedVac (vacuum concentrators) with caps open to completely
dry out the methanol. Finally, samples were reconstituted in 0.25 ml of Arbor Assays assay buffer, vortexed (10 sec), and the samples were placed for subsequent assay. The re-constituted extract was filtered using a Corning Costar Spin-X 0.45 μm cellulose acetate filter (VWR, Philadelphia, PA).

**Hot flashes and night sweats:**

Hot flashes and night sweats were recorded with the help of an ambulatory Biolog monitor. Participants were asked to wear the monitor for 24 hours; however, due to scheduling conflicts, humidity, and other personal reasons, participants wore the monitor for an average of about 10 hours and 8 minutes. For those participants who wore the monitors, I met with them in the morning as early as possible (6:00 am to 8:00 am) and explained what the monitor does and how to press the event marker when they felt a hot flash. Following this, with the help of an alcohol swab, the area of the skin on the upper chest was sanitized, and the electrodes were placed 4 inches apart from each other on either side of the sternum (Figure 8). Participants were asked to press the event marker when they felt a hot flash.
Figure 8: Participant wearing Biolog monitor, with electrodes placed 4 inches apart on both sides of the sternum.

Most participants who wore the monitor at night took a shower just before the electrodes were attached to their chest. This is because they lived in a region where the climate was hot with high humidity and, without air-conditioning, it was unpleasant and uncomfortable to sleep without taking a shower after their daily activities. A few women (n=3) expressed that they were unable to sleep with the electrodes on their chest as they were concerned about the electrodes falling off while others reported no disturbances from the electrodes in their sleep. I asked participants, regardless of their subjective hot flashes, to wear the monitors to understand whether there is a correlation between subjective and objective hot flashes.

Particular statistical analyses are covered in the next three chapters.
CHAPTER 3
FACTORS ASSOCIATED WITH SYMPTOMS AT MIDLIFE IN NAGALAND, INDIA

Introduction

Hot flashes and night sweats, commonly combined and referred to as vasomotor symptoms (VMS), are one of the most common complaints among midlife women. It is estimated that about 75% of menopausal women experience VMS and, in some, VMS can last up to 10 years or more (Avis et al. 2015; Hamoda et al. 2020). The characteristic symptoms of hot flashes are a sudden feeling of intense heat in the upper body, particularly in the neck, back, face, or chest, and can last up to several minutes. Symptoms of night sweats include excessive sweating at night, insomnia, and chills. VMS are frequently reported during the late perimenopausal and early postmenopausal phases of the transition from reproductive to post-reproductive life and have been attributed to thermoregulatory changes in the central nervous system in response to the lack of sex steroids (Freedman, 2001).

The physiology of VMS is not yet fully understood. Studies on VMS have looked at reproductive hormones such as estradiol, follicle-stimulating hormone (FSH), testosterone, dehydroepiandrosterone sulfate, sex hormone binding globulin, and hypothalamic KNDy neurons (Guthrie et al. 2005; Padilla et al. 2018; Rance et al. 2013; Randolph Jr et al. 2005; Schilling et al. 2007). For instance, results from the Study of Women’s Health Across the Nation (SWAN) have indicated higher FSH is associated with the prevalence and frequency of VMS among women at midlife (Randolph Jr et al. 2005). A study from the Women Health Initiative Observational Study demonstrated that
postmenopausal women with severe or late-occurring VMS were more likely to
demonstrate accelerated epigenetic aging, even after controlling for chronological age
(Thurston et al. 2020). More interestingly, Rometo et al. (2007) examined the presence
and potential changes in kisspeptin neurons in the hypothalamus of menopausal women
and ovariectomized monkeys. Results indicated a significant increase in the size and
number of kisspeptin-expressing neurons, as well as higher gene expression compared to
premenopausal women. Similar changes were noted in ovariectomized monkeys and
changes were attenuated by estrogen replacement. The authors further suggested that
kisspeptin neurons may play a role in regulating estrogen-negative feedback in humans.

VMS are distinctive symptoms of the menopausal transition. Factors associated
with VMS include ethnicity, obesity, lifestyle, stress, and other social and demographic
factors (Gold et al. 2004; Freeman et al. 2011; Kakkar et al. 2007; Melby et al. 2011;
Sievert et al. 2006; Sievert et al. 2018). In India, the percentage of women experiencing
hot flashes ranges from 39.4% to 78.2% (Dasgupta & Ray, 2015; Rulu et al. 2020;
Sharma et al. 2007; Sidhu et al. 2005), with some studies indicating a lower likelihood of
hot flashes with earlier age at menarche and a longer duration of breastfeeding (Dasgupta
& Ray, 2015). Based on a review by Makara-Studzińska et al. (2014), the global
prevalence of hot flushes from 2010-2013 was observed to be highest in Europe (97%,
particularly in Turkish women), followed by Australia (83%), Africa (77%), Asia (58%),
North America (52%), and South America (18%).

Previously, VMS that occurs during menopause or the menopausal transition were
not considered to be detrimental. This idea, however, has been challenged. For instance,
large cohort studies including longitudinal studies from the SWAN, Women’s Health...
Initiative (WHI), the Heart and Estrogen Replacement Study (HERS), and Women’s Ischemia Syndrome Evaluation (WISE) have suggested links between VMS and cardiovascular disease risk (Grady et al. 2002; Nudy et al. 2022; Thurston et al. 2017, 2021). Moreover, globally, women have reported disturbances in day-to-day activities because of flushing and perspiration, sleep disturbances, irritability, labile moods, and anxiety (Handley & Williams, 2015; Huang et al. 2008). As such, VMS are one of the most common reasons why women seek health care during or around menopause (Williams et al. 2007).

Hot flashes and night sweats have been measured subjectively through questionnaires, using a severity scale (e.g., none, a little, somewhat, a lot) or as frequencies (e.g., yes/no). Diaries of hot flashes or body diagrams have also been used to keep track of or locate where hot flashes have occurred (Kronenberg & Downey, 1987; Sievert et al. 2007). Skin temperature, skin conductance, core body temperature, and electrocardiograms have historically been used as objective measures of hot flashes (Freedman, 2000). Despite its limitations (Thurston et al. 2009, 2011), sternal skin conductance is the most widely used physiologic measure of hot flashes in multiple laboratories and ambulatory studies (de Bakker & Everaerd, 1996; Carpenter et al. 2004; Thurston et al. 2005; Sievert, 2007; Sievert et al. 2002). Ambulatory monitoring is widely used in field studies, as it serves as an important measure to document variations in objective hot flashes across populations and geographic locations. However, most studies that looked at the factors associated with VMS used subjective measures of VMS and not objectively measured VMS.
The objective of this chapter is to explore the most common symptoms experienced by women in this specific population and determine the factors associated with both subjective and objective measures of VMS with community-specific variables such as soy and spice consumption. This is the first study in Northeast India to measure objective hot flashes using ambulatory Biolog monitors. Furthermore, this chapter also examines symptoms not included in the GCS but that may impact women’s well-being or bother them, and examines the clustering of symptoms listed in the GCS to gain an understanding of their interrelationships.

**Methods**

**Participant selection and recruitment**

The cross-sectional study (n=151) was conducted in Nagaland, India from January 2021 to July 2021. Opportunity samples were obtained from 4 regions (Kohima, Dimapur, Mima, and Shaki) in Nagaland. Participants were recruited with the help of key informants – socially well-connected person located in the same geographic vicinity as the participants. The following were exclusion criteria: members of non-tribal populations, pregnant/lactating women, those who underwent hysterectomies, and those using hormone therapy. Informed signed consent was sought from all participants prior to the start of the interviews. The study was approved by the Institutional Review Board, University of Massachusetts, Amherst.

**Menopause status and symptoms at midlife**

Menopause stages were defined based on the STRAW+10 categories (Harlow et al. 2012), and participants were divided into 3 groups based on their menstrual pattern - premenopausal: no changes, heavier/lighter menses, or subtle changes in the cycle length;
perimenopausal: menstrual cycle changes of more than 6 days or an interval of amenorrhea of 2 or more months; and postmenopausal: no period for 12 months or more.

The Greene Climacteric Scale (GCS; Greene, 1976) was used to assess the frequency (yes/no) and severity (0-3) of symptoms at midlife experienced within the last 2 weeks. The scale consists of 21 symptoms rated on a scale from 0 (not at all) to 3 (extremely). Participants were also queried about other symptoms not included in the GCS that bothered them.

**Objective hot flashes and night sweats**

Objective hot flashes and night sweats were recorded with the help of an ambulatory Biolog monitor (UFI, model 3991/1-SCL; Morro Bay, CA) among a subset of participants (n=84). The Biolog monitor contains a microprocessor powered by a standard 9-V battery that measures changes in sternal skin conductance indicative of a hot flash or night sweats. A set of two silver/silver chloride electrodes was placed across the sternum, 4 inches apart, and participants were asked to wear the monitor for 24 hours; however, due to scheduling conflicts, humidity, and other personal reasons, participants wore the monitor for an average of about 10 hours. Participants were also asked to press the event marker when they felt a hot flash. A detailed description of the Biolog monitor has been published elsewhere (Sievert, 2013). The frequency of objective VMS was recorded based on the presence or absence of VMS, and severity was recorded based on the number of VMS events recorded by the Biolog monitor within the study period.

Most participants from Dimapur who wore the monitor at night took a shower before the electrodes were attached. This is because Dimapur’s climate is hot, with high humidity and without air-conditioning, it was unpleasant and uncomfortable to sleep.
without taking a shower after their daily activities. This, however, did not influence the experience of VMS. Participants wore the ambulatory monitors at various times between 5:24 to 21:04, and the average starting time was 11:44 (s.d. 4.73). The monitors were removed from 6:33 to 23:53 with a mean of 13:14 (s.d. 6.28). The duration of usage varied from 6 hours and 33 minutes to 23 hours and 53 minutes, with an average usage of 10 hours and 8 minutes (s.d. 2.47).

Socio-demographic variables and lifestyle variables

All women (n=151) completed the questionnaires, and general demographics such as age, age at menarche, and age at menopause. Anthropometric measures of height to the nearest 0.1 cm and weight to the nearest 0.1 kg were collected using an anthropometer rod and an analog weighing scale, respectively. Body mass index (BMI) was derived as weight in kilograms divided by height in meters squared. Thirteen community-specific socio-economic variables were queried, including occupation, income, education, number of children, employment of household helpers, and possession of cars and houses. Participant responses were summed to obtain a total socioeconomic score ranging from 0-62. A higher score indicates higher socio-economic status.

Questions about diet with a focus on foods and spices that may impact the experience of hot flashes were queried. As such, women were asked to report their intake of foods high in phytoestrogens, such as local soy products and spices such as Naga Morich or Raja Mircha. Soy is consumed by the Nagas mostly in the form of a fermented paste called Axone. Raja Mircha, also known as Naga Mirch, is a spicy chili pepper cultivated mainly in Northeast India and Bangladesh. This spice is a major part of the diet among
the Nagas. Mathur et al (2000) reported *Naga Morich/ Naga Jolokia* to be a variety of *Capsicum frutescens L*, that is about 855,000 Scoville Heat Units (SHUs).

**Perceived stress**

Perceived stress was collected with the help of the 10-item Perceived Stress Scale (PSS-10, Cohen et al. 1994). The PSS measures the degree to which situations in one’s life during the past month are considered stressful. For instance, participants were asked how often they felt nervous and stressed, and how often they felt that things were not going their way. Each question was answered on a Likert scale ranging from 0 to 4. Individual scores on the PSS can range from 0 to 40 with higher final scores indicating higher perceived stress. The total scores were categorized into 3 groups namely, low stress (0-13); moderate stress (14-26); and high perceived stress (27-40). The PSS is an important measure of one’s perception of an event, as the same event (e.g., menopause or COVID-19) can be perceived differently by different individuals.

**Statistical analysis**

Data analysis was conducted using R version 4.2.0 (R Core Team 2022). Continuous variables such as age, parity, recalled ages at menarche and menopause, and BMI were presented as mean, standard deviation, and range. Categorical variables such as tobacco use (yes/no), symptoms at midlife (yes/no), and consumption of spicy food (yes/no) and soy (yes/no) were presented as frequencies and percentages. Education level was treated as an ordinal variable and was reported in frequencies and percentages for each category, which included illiterate, less than high school, high school degree, and college degree or higher. For analyses associated with biometrically measured hot flashes, I excluded 67 women because of missing data on objective VMS. Thus, 84
women were included in the analyses of the Biolog data. The entire sample (n=151) was included in the analyses of self-reported subjective VMS.

Principal component analysis (PCA) was performed to evaluate symptom groupings. Based on the scree plot, the symptoms were assigned to four factors, and these factors were rotated using the varimax rotation, which maintains statistical independence between factors and optimizes factor loadings while simplifying factor interpretation (Abdi, 2003). The factors were labeled and interpreted using factor loadings equal to or greater than 0.3.

To assess the correlation and agreement between subjective and objective vasomotor symptoms, Cohen’s Kappa, Phi and Cramer’s V values were calculated. Additionally, generalized linear modeling (GLM) was employed to conduct logistic regression using the ‘glm’ function in RStudio. The outcome variables, objective VMS and subjective VMS, were treated as binary variables with coding of ‘yes’ represented by 1 and ‘no’ represented by 0. I used corrected Akaike’s Information Criterion (AICc) to determine the best-fit model. Three models each for subjective and objective VMS were constructed (Table 3.1). Base models included covariates such as sleep problems, SES, PSS, and BMI based on a priori studies (Gold et al. 2004; Freeman et al. 2011; Kakkar et al. 2007; Melby et al. 2011; Sievert et al. 2006; Sievert et al. 2018). The diet model includes consumption of soy and spice with menopause status, and the third model includes all the variables from the base and diet model. The model with the smallest AICc value was considered the best model. This model selection is a useful tool when heterogeneity is small (Brewer et al. 2016) in a dataset, which is the case with this data.
Table 3.1. Contending models

<table>
<thead>
<tr>
<th>Model names</th>
<th>variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective VMS Base model</td>
<td>BMI + sleep + PSS + SES + menopause status</td>
</tr>
<tr>
<td>Objective VMS Diet model</td>
<td>Soy + spicy food + menopause status</td>
</tr>
<tr>
<td>Objective VMS Full model</td>
<td>BMI + sleep + PSS + SES + soy + spicy food + menopause status</td>
</tr>
<tr>
<td>Subjective VMS Base model</td>
<td>BMI + sleep + PSS + SES + menopause status</td>
</tr>
<tr>
<td>Subjective VMS Diet model</td>
<td>Soy + spicy food + menopause status</td>
</tr>
<tr>
<td>Subjective VMS Full model</td>
<td>BMI + sleep + PSS + SES + soy + spicy food + menopause status</td>
</tr>
</tbody>
</table>

**Results**

For the total sample, women on average were 44 years of age and had a mean recalled age at menarche of 14 years. Out of 151 women, 51 had undergone natural menopause and had a mean recalled age at natural menopause of 47 years. Most women were homemakers (45.7%) and had obtained less than a high school degree (41%). The frequency of tobacco usage and consumption of soy and spice was found to be 25.8%, 87.4%, and 73.5%, respectively (Table 3.2). Based on the Asian cut-off for BMI (WHO 2004), women were on average overweight (mean 23.8 kg/m²). The majority (93.4%) of women reported having moderate stress. Of the 84 participants who wore the monitor, 48.8% experienced objective VMS. The average number of objective VMS experienced over a 24-hour period was found to be 1.6±2.42 and ranged from 0 to 9 times across the day and night.
Table 3.2: Summary statistics

<table>
<thead>
<tr>
<th>Category</th>
<th>n</th>
<th>% or mean ± SD (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>151</td>
<td>44.1± 5.13 (40-55)</td>
</tr>
<tr>
<td>Recalled age at natural menopause (years)</td>
<td>51</td>
<td>47.0± 3.38 (35-53)</td>
</tr>
<tr>
<td>Recalled age at menarche (years)</td>
<td>146</td>
<td>14.08± (11.0-17.5)</td>
</tr>
<tr>
<td>SES</td>
<td>151</td>
<td>35.9±7.57 (22-56)</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homemaker</td>
<td>69</td>
<td>45.7</td>
</tr>
<tr>
<td>Farmer</td>
<td>48</td>
<td>31.8</td>
</tr>
<tr>
<td>Public/private sector worker</td>
<td>34</td>
<td>22.5</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>35</td>
<td>23.2</td>
</tr>
<tr>
<td>Less than high school</td>
<td>62</td>
<td>41.0</td>
</tr>
<tr>
<td>High school degree</td>
<td>38</td>
<td>25.2</td>
</tr>
<tr>
<td>College degree or higher</td>
<td>16</td>
<td>10.6</td>
</tr>
<tr>
<td><strong>Tobacco use</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>39</td>
<td>25.8</td>
</tr>
<tr>
<td>No</td>
<td>112</td>
<td>74.2</td>
</tr>
<tr>
<td><strong>Soy consumption</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>132</td>
<td>87.4</td>
</tr>
<tr>
<td>No</td>
<td>19</td>
<td>12.6</td>
</tr>
<tr>
<td><strong>Spice consumption</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>111</td>
<td>73.5</td>
</tr>
<tr>
<td>No</td>
<td>40</td>
<td>26.5</td>
</tr>
<tr>
<td><strong>Menopause status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Premenopause</td>
<td>79</td>
<td>52.3</td>
</tr>
<tr>
<td>Perimenopause</td>
<td>21</td>
<td>13.9</td>
</tr>
<tr>
<td>Postmenopause</td>
<td>51</td>
<td>33.8</td>
</tr>
<tr>
<td><strong>Objective VMS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severity (number of VMS events)</td>
<td>84</td>
<td>1.6±2.42 (0-9)</td>
</tr>
<tr>
<td>Frequency (yes/no)</td>
<td>84</td>
<td>48.8</td>
</tr>
<tr>
<td><strong>Subjective VMS (yes/no)</strong></td>
<td>151</td>
<td>62.3</td>
</tr>
<tr>
<td><strong>Perceived Stress Scale-10</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low stress</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>Moderate stress</td>
<td>141</td>
<td>93.4</td>
</tr>
<tr>
<td>High perceived stress</td>
<td>8</td>
<td>5.3</td>
</tr>
<tr>
<td><strong>Body Mass Index (kg/m²)</strong></td>
<td>151</td>
<td>23.81± 4.22 (12.42-38.96)</td>
</tr>
</tbody>
</table>
The frequencies of 20 symptoms at midlife based on the Greene Climacteric Scale are presented in Table 3.3. The most prevalent symptoms were headaches (70.2%), tiredness and lack of energy (67.5%), and hot flashes (58.3%). Among premenopausal women, headaches (75.9%), tiredness and lack of energy (63.3%), hot flashes and heart palpitations (both 53.2%) were the most common symptoms. Among perimenopausal women, headaches (81%), followed by tiredness or lack of energy (76.2%), and heart palpitations (71.4%) were the most common symptoms. The experience of hot flashes was the 4th most common symptom among perimenopausal women. Postmenopausal women, on the other hand, commonly experienced tiredness or lack of energy (70.6%), hot flashes (62.7%), and sleep difficulties (58.8%). Symptoms such as headaches, sleep difficulties, feeling unhappy or depressed, and feeling dizzy or faint were found to be significantly different among women by menopausal status.
Table 3.3: Frequency of symptoms at midlife (%)

<table>
<thead>
<tr>
<th>Symptoms at midlife</th>
<th>All (n=151)</th>
<th>Menopause status</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pre-</td>
<td>Peri-</td>
</tr>
<tr>
<td>Headaches</td>
<td>70.2</td>
<td>75.9</td>
<td>81.0</td>
</tr>
<tr>
<td>Feeling tired or lacking in energy</td>
<td>67.5</td>
<td>63.3</td>
<td>76.2</td>
</tr>
<tr>
<td>Hot flashes</td>
<td>58.3</td>
<td>53.2</td>
<td>66.7</td>
</tr>
<tr>
<td>Heart beating quickly or strongly</td>
<td>53.6</td>
<td>53.2</td>
<td>71.4</td>
</tr>
<tr>
<td>Muscle and joint pains</td>
<td>51.0</td>
<td>49.4</td>
<td>52.4</td>
</tr>
<tr>
<td>Feeling tense or nervous</td>
<td>48.3</td>
<td>46.8</td>
<td>52.4</td>
</tr>
<tr>
<td>Difficulty in sleeping</td>
<td>47.7</td>
<td>38.0</td>
<td>57.1</td>
</tr>
<tr>
<td>Sweating at night</td>
<td>39.1</td>
<td>38.0</td>
<td>42.9</td>
</tr>
<tr>
<td>Feeling unhappy or depressed</td>
<td>39.1</td>
<td>31.6</td>
<td>33.3</td>
</tr>
<tr>
<td>Breathing difficulties</td>
<td>30.5</td>
<td>32.9</td>
<td>28.6</td>
</tr>
<tr>
<td>Difficulty in concentrating</td>
<td>25.2</td>
<td>20.3</td>
<td>28.6</td>
</tr>
<tr>
<td>Feeling dizzy or faint</td>
<td>24.5</td>
<td>25.3</td>
<td>42.9</td>
</tr>
<tr>
<td>Attacks of anxiety, panic</td>
<td>22.5</td>
<td>16.5</td>
<td>33.3</td>
</tr>
<tr>
<td>Parts of body feel numb</td>
<td>21.9</td>
<td>25.3</td>
<td>23.8</td>
</tr>
<tr>
<td>Loss of feeling in hands or feet</td>
<td>21.2</td>
<td>20.3</td>
<td>38.1</td>
</tr>
<tr>
<td>Pressure or tightness in head</td>
<td>16.6</td>
<td>13.9</td>
<td>28.6</td>
</tr>
<tr>
<td>Loss of interest in most things</td>
<td>15.2</td>
<td>13.9</td>
<td>9.5</td>
</tr>
<tr>
<td>Irritability</td>
<td>12.6</td>
<td>10.1</td>
<td>14.3</td>
</tr>
<tr>
<td>Excitable</td>
<td>7.3</td>
<td>8.9</td>
<td>4.8</td>
</tr>
<tr>
<td>Crying spells</td>
<td>6.6</td>
<td>6.3</td>
<td>9.5</td>
</tr>
</tbody>
</table>

*p<0.05; Bold values represent the most common symptoms; Symptom experience assessed by GCS in the past 2 weeks

Out of 151 participants, 25 participants reported having experienced symptoms not listed in the GCS (Table 3.4). Heaviness (9.9%), chills (4.6%), tingling in the body and extremities (1.3%), and bloating (1.3%) were reported by women in Nagaland.
Table 3.4: New symptom lists among women in Nagaland.

<table>
<thead>
<tr>
<th>New symptom list</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heaviness</td>
<td>15</td>
<td>9.9</td>
</tr>
<tr>
<td>Chills</td>
<td>7</td>
<td>4.6</td>
</tr>
<tr>
<td>Tingling in the body and extremities</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>Bloating</td>
<td>2</td>
<td>1.3</td>
</tr>
</tbody>
</table>

The factor analysis identified 4 factors that explained 43.8% of the total symptom variance in the population (Table 3.5). Factor 1 was characterized by symptoms related to heart palpitations, difficulty in sleeping, attacks of anxiety and panic, difficulty in concentrating, feeling tired or lacking in energy, loss of interest in most things, and feeling unhappy or depressed. These symptoms were attributed to emotional instability, as indicated by factor loadings greater than 0.3. Factor 2 encompassed vaso-somatic symptoms such as heart beating quickly or strongly, difficulty in sleeping, feeling tired or lacking in energy, headaches, hot flashes, and night sweats. Symptoms related to mood disturbance, including excitability, attacks of anxiety and panic, loss of interest in most things, crying spells, and breathing difficulties, are loaded into factor 3. Finally, factor 4 was characterized as aches and pains with symptoms such as feeling dizzy or faint, pressure or tightness in the head, parts of the body feeling numb, muscle and joint pains, and loss of feeling in hands or feet.
Table 3.5: Factor loadings for symptoms at midlife

<table>
<thead>
<tr>
<th>Greene climacteric scale menopausal symptoms</th>
<th>Emotional instability</th>
<th>Vaso-somatic symptoms</th>
<th>Mood disturbances</th>
<th>Aches and pains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart beating quickly or strongly</td>
<td>0.3269</td>
<td>0.3317</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeling tense or nervous</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty in sleeping</td>
<td>0.4918</td>
<td>0.3023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excitable</td>
<td></td>
<td></td>
<td>0.7844</td>
<td></td>
</tr>
<tr>
<td>Attacks of anxiety, panic</td>
<td>0.7293</td>
<td>0.4244</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty in concentrating</td>
<td>0.6928</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeling tired or lacking in energy</td>
<td>0.4269</td>
<td>0.3654</td>
<td>0.3814</td>
<td></td>
</tr>
<tr>
<td>Loss of interest in most things</td>
<td>0.3663</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeling unhappy or depressed</td>
<td>0.6750</td>
<td></td>
<td></td>
<td>0.6806</td>
</tr>
<tr>
<td>Crying spells</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irritability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeling dizzy or faint</td>
<td>0.6371</td>
<td></td>
<td>0.6314</td>
<td></td>
</tr>
<tr>
<td>Pressure or tightness in head</td>
<td></td>
<td></td>
<td></td>
<td>0.5075</td>
</tr>
<tr>
<td>Parts of body feel numb</td>
<td>0.5075</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Headaches</td>
<td>0.4302</td>
<td></td>
<td>0.3714</td>
<td></td>
</tr>
<tr>
<td>Muscle and joint pains</td>
<td></td>
<td></td>
<td></td>
<td>0.6417</td>
</tr>
<tr>
<td>Loss of feeling in hands or feet</td>
<td></td>
<td></td>
<td>0.3366</td>
<td></td>
</tr>
<tr>
<td>Breathing difficulties</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hot flashes</td>
<td>0.7230</td>
<td></td>
<td></td>
<td>0.7572</td>
</tr>
<tr>
<td>Night sweats</td>
<td>0.7572</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Factors include >0.30 loadings; extraction method: Principal component analysis; rotation: Varimax.

A correlation and agreement between subjective and objective measures of vasomotor symptoms indicated a poor agreement (Cohen’s kappa = -0.18, p=0.07).

Additionally, the Phi and Cramer’s V values were found to be -0.19 and 0.19, respectively. However, the association was not statistically significant (p=0.07), indicating a weak correlation.

Based on Table 3.6, after controlling for menopausal status, the best model for biometrically measured VMS includes BMI, sleep problems, perceived stress, and socioeconomic status. This model has the lowest AICc value (111.90) and the highest weight of evidence (w_i=0.765). Similarly, for self-reported subjective VMS, after controlling for menopause status, the best model includes BMI, sleep problems, perceived stress, and socioeconomic status. This model has the lowest AICc value of
97.21 and the highest weight of evidence ($w_i=0.57$). In addition, the subjective VMS full model was found to be equally good with an AICc value of 98.0.

<table>
<thead>
<tr>
<th>Models</th>
<th>AICc</th>
<th>ΔAICc</th>
<th>$w_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biometrically measured VMS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI + sleep + PSS + SES + menopause status</td>
<td>111.90</td>
<td>0.000</td>
<td>0.765</td>
</tr>
<tr>
<td>Soy + spicy food + menopause status</td>
<td>115.24</td>
<td>3.339</td>
<td>0.144</td>
</tr>
<tr>
<td>BMI + sleep + PSS + SES + soy + spicy food + menopause status</td>
<td>116.19</td>
<td>4.286</td>
<td>0.089</td>
</tr>
<tr>
<td><strong>Self-reported subjective VMS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI + Sleep + PSS + SES + menopause status</td>
<td>97.21</td>
<td>0.000</td>
<td>0.578</td>
</tr>
<tr>
<td>soy + spicy food + menopause status</td>
<td>103.02</td>
<td>5.812</td>
<td>0.031</td>
</tr>
<tr>
<td>BMI + Sleep + SES + PSS + soy + spicy food + menopause status</td>
<td>98.0</td>
<td>0.790</td>
<td>0.389</td>
</tr>
</tbody>
</table>

VMS=Vasomotor symptoms; PSS=perceived stress scale; SES=socioeconomic status; BMI=Body mass index; AICc= Akaike information criterion; Δ=delta; $w_i$=weights

Logistic regression analyses of the best models were performed to estimate the association of factors with objective and subjective VMS (Table 3.7). SES was found to be significantly associated with objective vasomotor symptoms (OR=1.09, 95% CI=1.012-1.184). However, sleep problems were found to be associated with subjective vasomotor symptoms in both the subjective base model (OR=5.4, 95% CI = 1.777-18.830) and the subjective full model (OR=4.68, 95% CI = 1.479-16.38).
Table 3.7: Standardized estimates for biometrically measured and self-reported subjective vasomotor symptoms

<table>
<thead>
<tr>
<th>Variable</th>
<th>Objective base VMS model</th>
<th>Subjective base VMS model</th>
<th>Subjective VMS full model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
<td>OR</td>
</tr>
<tr>
<td>BMI</td>
<td>0.915</td>
<td>0.792-1.045</td>
<td>0.889</td>
</tr>
<tr>
<td>Sleep problems</td>
<td>0.577</td>
<td>0.190-1.669</td>
<td>5.465</td>
</tr>
<tr>
<td>SES</td>
<td>1.090</td>
<td>1.012-1.184</td>
<td>1.002</td>
</tr>
<tr>
<td>PSS</td>
<td>1.135</td>
<td>0.969-1.343</td>
<td>1.029</td>
</tr>
<tr>
<td>perimenopause</td>
<td>1.951</td>
<td>0.493-8.404</td>
<td>1.253</td>
</tr>
<tr>
<td>postmenopause</td>
<td>1.540</td>
<td>0.471-5.319</td>
<td>2.70</td>
</tr>
<tr>
<td>Soy consumption</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Spice consumption</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**p<0.01; p<0.05; VMS= vasomotor symptoms; PSS= perceived stress scale (0-40); SES= socioeconomic status (0-62); BMI=Body mass index**


**Discussion and conclusion**

Numerous ongoing findings from the SWAN, WHI, HERS, and WISE continue to yield important information about vasomotor symptoms and their risk factors (Grady et al. 2002; Nudy et al. 2022; Thurston et al. 2017; Thurston et al. 2021). In the present study, I found that socioeconomic status and sleep problems were independently linked to biometrically measured objective hot flashes and self-reported subjective hot flashes, respectively, after controlling for menopausal status. These differences in the associated factors of VMS suggest that the ambulatory Biolog monitor captures distinct information from the self-reported subjective hot flashes gleaned from questionnaires.

This study reported headaches, tiredness and lack of energy, and hot flashes as the most common symptoms experienced by Naga women, which is consistent with reports from other studies in India (Akhtar et al. 2018; Kapur et al. 2009; Thakur et al. 2019) and the United States (Craig & Mitchell, 2016; De Mello et al. 2021). Additionally, sleep problems and feeling unhappy or depressed were statistically higher among postmenopausal women, and headaches and feeling dizzy or faint were statistically higher among perimenopausal women. There was no significant difference observed in the reports of hot flashes or night sweats among pre-, peri-, or post-menopausal Naga women.

Through the factor analysis conducted on the 20 items of menopausal symptoms, four factors were identified, which included symptoms associated with emotional instability, vaso-somatic symptoms, mood disturbances, and aches and pains. Consistent with findings where psychosocial symptoms were extracted as the first factor (Avis et al. 1993; Chattha et al. 2008; Sievert et al. 2007), results from this study also loaded...
symptoms related to emotional instability as the first factor. This factor comprises symptoms such as attacks of anxiety and panic, difficulty in concentrating, feeling tired or lacking in energy, loss of interest in most things, and feeling unhappy or depressed.

Results from the SWAN indicated that subjective VMS upon waking, but not physiologically monitored or diary-reported VMS during the night, were related to poorer actigraphy-assessed sleep continuity and poorer subjective sleep ratings (Thurston et al. 2012). This study indicated that subjectively recorded severe sleep problems, rated on a scale from 0-3, were associated with worse subjective VMS, but not objective VMS. There were no significant associations observed between the consumption of spicy food and soy with objective or subjective hot flashes.

Higher socioeconomic status indicated higher numbers of objective, biometrically measured VMS. This finding contrasts with studies that indicated an inverse association using questionnaires to measure hot flashes (Gold et al. 2000; Kumari et al. 2005; Utian 2005). A cross-sectional study from Kanpur, India indicated higher odds of reporting subjective vasomotor symptoms (OR=3.4, CI=1.0-10.9) among women from lower middle class compared to poor or upper middle class of socioeconomic status (Thakur et al. 2019). However, this study also looked at the association between subjective VMS and SES and not objective VMS.

These findings are of interest for several reasons. This is the first study to use Biolog monitors to assess objective hot flashes in Northeast India. Although a causal relationship between VMS and its determinants cannot be established due to the cross-sectional nature of the study, the results reported here add to the existing body of literature on VMS experience and variation across the Indian subcontinent. More
importantly, this study distinguishes the factors associated with subjectively and objectively reported VMS and highlights the importance of differentiating the two in future studies to deepen our understanding of the complex dynamics between subjective and objective VMS and its associates. This study also highlights the need to understand sleep in the context of menopause-associated VMS as indicated by multiple studies (Joffe et al. 2009; Thurston et al. 2012).
CHAPTER 4

MIDLIFE SYMPTOMS AND HOUSEHOLD STRESS ARE ASSOCIATED WITH FINGERNAIL CORTISOL

Introduction

Stress is a state of disharmony caused by different pressures or challenges faced in our everyday lives. These challenges can be physical, environmental, or psychological. According to Chrousos & Gold (1992), stress is a result of threatened homeostasis. Stressors or stressful life events can occur in different forms and can threaten one’s well-being. As Lazarus & Folkman (1984) explain, stressors can threaten one’s physical integrity or psychosocial well-being. These terms carry a negative connotation, but a stress response is essential for adaptation and survival. Normal functioning of the stress response is essential to respond to a stressor quickly and efficiently for the body to recover or return to homeostasis.

The study of stress physiology is important as multiple studies connect chronic stress to a host of health issues, ranging from compromised cardiovascular health and immune function to poor cognitive and psychological health (Dimsdale, 2008; Glaser et al. 1992; Glaser & Kiecolt-Glaser, 2005, 2009; Harris et al. 2022; Slopen et al. 2012; Steptoe & Kivimäki, 2012; Sumner et al. 2015). During a stress response, the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system (SNS) are activated, resulting in a physiological change or adaptation so the organism can deal with the threat (Maier & Watkins, 1998). When faced with a threat, the hypothalamus releases a hormone called corticotropin-releasing hormone (CRH) that stimulates the pituitary gland to release adrenocorticotropic hormone (ACTH) into the bloodstream.
ACTH then travels to the adrenal glands, which are located on top of the kidneys, and stimulates the release of cortisol – a stress hormone (Miller & O'Callaghan, 2002). Cortisol is a steroid hormone that helps in mediating the stress response and regulating metabolism, inflammatory responses, and immune function (Oakley & Cidlowski, 2013). Cortisol can be measured in blood, urine, saliva, and fingernails (Cagnacci et al. 2012; Gerber et al. 2017; Katainen et al. 2018; Warnock et al. 2010) and is often used as a biomarker of stress and can provide important information on a person’s stress response and overall health.

Acute stress and chronic stress are two major forms of stress (APA, 2011). These stress types are differentiated in terms of their duration, characteristics, and symptoms. Acute stress or the “fight or flight response” is a brief or immediate response, triggered by “the demands and pressures of the recent past and anticipated demands and pressures of the near future” (APA, 2011). Chronic stress, on the other hand, is a prolonged response to ongoing stressors, such as financial difficulties, relationship problems, or a high-stress job. Chronic stress can have negative effects on your physical and mental health, as it can increase the risk of developing conditions such as heart disease (Troxel et al. 2003). Exposure to a severe acute stressor or repeated exposure to a stressor can lead to changes in psychosocial and neurological processes, and if these reactive processes persist, vulnerable individuals may develop stress-related disorders such as depressed mood, anxiety, and other somatic symptoms (e.g., headache). Stress can also cause inflammation (Black, 2002; Black & Garbutt, 2002) and trigger the immune system to decline prematurely, potentially increasing the likelihood of illness and age-related conditions (Burns & Goodwin, 1990). Numerous studies have provided convincing
evidence to demonstrate the relationship between psychosocial stressors and the development of illnesses (Glaser et al. 1992; Kiecolt-Glaser et al. 1996, 2002; Segerstrom & Miller, 2004). Consistent with this notion, Cohen et al. (1991) demonstrated that participants who were inoculated with one of the five respiratory viruses showed a dose-response relationship between psychological stress and a heightened risk of acute infectious respiratory illness.

Stress can be exacerbated due to various factors, including life changes (e.g., menopause), health problems, and financial and relationship problems. Menopause, a natural biological process that signals the end of reproductive life, is marked by a decline in the levels of reproductive hormones – estrogen and progesterone – produced by the ovaries. Hormonal changes that occur during menopause can cause fluctuations and disrupt the balance of hormones that are important for regulating symptoms during midlife. Additionally, the decline or fluctuations in estrogen can also affect the HPA axis, resulting in experiencing stress and anxiety among menopausal women (Li & Graham, 2017; Halbreich & Kahn, 2001; Kirschbaum et al. 1999). In general, stress can have an impact on overall health and increase the risk of chronic diseases such as cardiovascular disease among menopausal women.

During menopause, the decrease in estrogen levels can cause the blood vessels to constrict, which can lead to an increase in blood pressure (Miller & Duckles, 2008; Rodrigues et al. 2022; White, 2002). Additionally, weight gain, which is common during menopause, can also contribute to the development of hypertension (Kodoth et al. 2022; Wing et al. 1991). Some studies have also suggested that hot flashes, a common symptom of menopause, may be associated with changes in blood pressure (Baker et al. 2019;
Brown et al. 2011; Gerber et al. 2007; Jackson et al. 2016; James et al. 2004). A study from Japan investigating the relationship between mental and physical stress, cardiovascular responses, and oxidative stress in premenopausal and postmenopausal women indicated that mental stress caused sustained diastolic blood pressure elevation in postmenopausal women, accompanied by heightened oxidative stress, while physical stress did not (Morimoto et al. 2008).

Perceived stress is a person's subjective experience of the demands placed on them and their ability to cope with them. Studies suggest that perceived stress can exacerbate menopausal symptoms such as hot flashes, night sweats, and mood changes (Alexander et al. 2007; Freeman et al. 2007; Nosek et al. 2010; Sievert et al. 2018). Perceived stress may also affect a woman's overall well-being during menopause. It can contribute to the development of mental health conditions such as anxiety and depression and can also have negative effects on physical health, such as increasing the risk of cardiovascular disease.

The study presented here was carried out in Nagaland, India – a rural state located in the northeast of India. Nagaland is home to over 16 tribes, with a population of 2 million people (Census, 2011). The studied population, Nagas have experienced unique community-specific stressors such as insurgency and political problems that have been ongoing since India gained its independence from Britain. Currently, the Naga insurgency, which is India's longest insurgency (Chasie & Hazarika, 2009:54), coupled with the ongoing political climate in India, has been an obstacle to political, economic, and social development in Nagaland (Ganguly & Findler 2009). For instance, internal strife and factionalism have led to multiple insurgent groups and these groups have
imposed heavy extorsions and taxes on the state residents, perpetuating a cycle of conflict and instability within the community (e.g., Zagefka & Jamir, 2015). In this study, I examined stress in relation to menopausal, community, and household-specific stressors. I also assessed measures of stress (fingernail cortisol for chronic stress, blood pressure for acute stress, and perceived stress) to understand whether stressors such as menopausal symptoms, household, and community problems are associated with these measures of stress. I hypothesize that an increased frequency of menopausal symptoms, household problems, and community stressors unique to Nagaland are associated with elevated markers of stress such as fingernail cortisol, blood pressure, and perceived stress.

**Methods**

From January to July 2021, a cross-sectional study was conducted in Nagaland, India, involving 151 participants (aged 40-55) recruited from four regions (Kohima, Dimapur, Mima, and Shaki) within Nagaland using an opportunity sampling method. Potential participants were excluded if they were from non-tribal populations, pregnant or lactating, had undergone hysterectomies, or were using hormone therapy. Strict safety protocols were implemented due to the COVID-19 Delta variant outbreak, and appropriate passes were obtained from authorities to visit each community. No positive COVID-19 cases were reported among participants during data collection. Signed informed consent was obtained from all participants, and the Institutional Review Board at the University of Massachusetts, Amherst approved the study.
Markers of Stress

Fingernail cortisol

Past studies have found that long-term cortisol levels can be effectively measured in fingernails (Fischer et al. 2020; Nejad et al. 2016; Warnock et al. 2010; Wu et al. 2018). To collect fingernail samples, participants were provided with a nail clipper and instructed to clip their nails directly into a Ziploc bag or onto a piece of white paper to prevent any loss of clippings. Those with shorter nails were given a Ziploc bag and asked to clip their nails after three weeks or more. Out of 151 participants, fingernail samples were obtained from 122 individuals and out of which nine participants reported using nail polish. The samples were labeled with the participant’s ID, stored at room temperature, and transported to Dr. Jerrold Meyer’s laboratory at the University of Massachusetts Amherst. The fingernail samples were analyzed for cortisol levels using the Arbor Assays DetectX enzyme immunoassay kit, as per the procedures described by Jankovic-Rankovic et al. (2020).

Blood pressure

Resting blood pressure was recorded with the help of an aneroid sphygmomanometer and stethoscope. Participants were seated comfortably with their left arm resting on a table or chair arm at heart level, and the sleeve was rolled up. The cuff of the sphygmomanometer was wrapped around the upper arm and inflated up to 50 mmHg above the expected systolic pressure, and the pressure was slowly released while listening for the Korotkoff sounds to record systolic and diastolic blood pressure.

The blood pressure categories utilized in this study were established by the American Heart Association (AHA; 2023) for the adult population. The categories
consist of six distinct levels, which are as follows: normal blood pressure, defined as having a systolic blood pressure (SBP) that is less than 120 mmHg and diastolic blood pressure (DBP) that is less than 80 mmHg; elevated blood pressure, characterized by SBP between 120-129 mmHg and a DBP that is less than 80 mmHg; stage 1 hypertension, indicated by SBP between 130-139 mmHg or a DBP between 80-89 mmHg; stage 2 hypertension, marked by SBP of 140 mmHg or higher or a DBP of 90 mmHg or higher; and hypertensive crisis denoted by SBP over 180 mmHg or a DMP over 120 mmHg. AHA categories of blood pressure were used to denote various levels, while continuous values of systolic and diastolic blood pressure were used in the regression analysis.

**Perceived stress**

The 10-item Perceived Stress Scale (PSS-10, Cohen et al. 1994) was used to collect data on perceived stress. The scale measures how stressful participants considered situations in their lives to have been during the previous month. Participants responded to questions on a Likert scale from 0 to 4, with higher scores indicating higher perceived stress. Scores were grouped into low, moderate, and high perceived stress categories. Categories were used for denoting the degrees of perceived stress and continuous values were used in the regression analysis.

**Stressors**

**Menopausal symptoms**

Menopausal symptoms were evaluated using the Greene Climacteric Scale (GCS; Greene, 1976), a scale frequently used in India (Kaur & Kaur, 2022) that assesses the frequency and severity of menopausal symptoms experienced in the last two weeks. The scale includes 21 symptoms rated on a scale from 0 (not at all) to 3 (extremely) and was
analyzed using exploratory factor analysis to identify symptom subgroups. A previous analysis from this Nagaland population identified four symptom subgroups: emotional instability (heart beating quickly or strongly, difficulty in sleeping, attacks of anxiety and panic, difficulty in concentrating, feeling tired or lacking in energy, loss of interest in most things, feeling unhappy or depressed), vaso-somatic symptoms (heart beating quickly or strongly, difficulty in sleeping, feeling tired or lacking in energy, headaches, hot flashes, and night sweats), mood disturbance (excitable, attacks of anxiety and panic, loss of interest in most things, crying spells, and breathing difficulties), and aches and pains (feeling dizzy or faint, pressure or tightness in head, parts of body feel numb, muscle and joint pains, and loss of feeling in hands or feet). These four factors accounted for 43.8% of the total symptom variance in the population (Rulu, 2023).

**Household stressors**

The assessment of household stressors involved inquiries pertaining to the presence of stress within the household such as, Is there a presence of stress within your household? (yes/no) Have you experienced financial hardship as a result of these stressors? (yes/no) Are there potential health implications as a result of the stress you are experiencing? (yes/no). Specific stressors were also recorded as open-ended responses. The binary responses were coded as 0-no, 1-yes, and summed to construct a measure of overall household stressor (0-3).

**Community stressors**

To measure community stressors, a set of questions were employed that encompassed various dimensions of insurgency-related issues and political conflict in Nagaland. Participants were asked whether they or their family members have been
impacted by insurgency-related and political-related problems, whether they have witnessed shooting within the state, and whether the tax imposed by factions had caused a burden on their family. Additionally, participants were queried about damage to personal belongings, injuries due to factional or political violence, or disruptions in their daily activities. These nine questions were designed as dichotomous (yes/no) and aggregated to ascertain each participant’s level of stress from community-level sources (0-9).

**Covariates**

Body mass index (BMI) and socioeconomic status (SES) were included as covariates. To obtain anthropometric measures, height to the nearest 0.1 cm and weight to the nearest 0.1 kg were recorded using an anthropometer rod and an analog weighing scale, respectively. BMI was then calculated as weight in kilograms divided by height in meters squared. In addition, information on 13 socioeconomic variables were collected including occupation, income, education, number of children, employment of household helpers, and possession of cars and houses. The total SES score, which ranged from 0-62 and represents higher SES with a higher score, was obtained by adding together the participant’s responses to the variables.

**Statistical analysis**

The data analysis was performed using STATA version 14 (College Station, TX, USA). Mean, standard deviation, and range were used to present continuous variables such as age, recalled age at menopause, BMI, fingernail cortisol level, and blood pressure, while categorical variables such as education, menopausal status, and levels of perceived stress were presented as frequencies and percentages. A total of 119
participants were included in the regression models. Participants with missing outcome variables (n=32) were excluded from the regression models. Multiple linear regression models were employed to determine the relationship between stressors (menopausal symptoms, household stressors, and community stressors) and markers of stress (fingernail cortisol, blood pressure, and perceived stress). Furthermore, blood pressure readings were categorized into normal (coded as 0), and hypertensive (coded as 1), and logistic regression was performed to investigate the potential influence of systolic and diastolic blood pressure on stressors.

The participant’s responses to the question “What stresses you?” were compiled in an Excel spreadsheet and subsequently exported to NVivo software. Using NVivo 12, a textual representation of frequently occurring household stressors was constructed in the form of a word cloud, with the objective of examining the categories of stressors that caused concern among women in Nagaland, India. Additionally, interviews on the same question were translated from Nagamese and Lotha dialects to English, and excerpts were also used to supplement the word cloud.

**Results**

On average, participants were aged 44 years and, among women who had undergone menopause (n=51), the average recalled age at menopause was 47 years. The majority of participants were homemakers (46%) and had less than a high school education (64%), while more than half of the participants were premenopausal (52%). Based on the perceived stress scale-10, it was observed that the majority of women (93.4%) reported having moderate stress. The mean blood pressure level was 126 mmHg over 81 mmHg, and the women were on average overweight based on the Asian cut-off
for BMI (WHO, 2004). Notably, approximately half of the participants had systolic blood pressure and diastolic blood pressure within the normal range, accounting for 45% and 40.4% of the sample, respectively.

Table 4.1: Sample characteristics

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>% or mean ± SD (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>151</td>
<td>44.1± 5.13 (40-55)</td>
</tr>
<tr>
<td>Recalled age at natural menopause (years)</td>
<td>51</td>
<td>47.0± 3.38 (35-53)</td>
</tr>
<tr>
<td>Socioeconomic status index</td>
<td>151</td>
<td>35.9±7.57 (22-56)</td>
</tr>
</tbody>
</table>

**Occupation**
- Homemaker: 69, 45.7
- Farmer: 48, 31.8
- Public/private sector worker: 34, 22.5

**Education**
- Illiterate: 35, 23.2
- Less than high school: 62, 41.0
- High school degree: 38, 25.2
- College degree or higher: 16, 10.6

**Menopause status**
- Premenopause: 79, 52.3
- Perimenopause: 21, 13.9
- Postmenopause: 51, 33.8

**Fingernail cortisol (log10)**
119, 0.37± 0.22 (-0.40-0.88)

**Perceived Stress Scale-10**
- Low stress: 2, 1.3
- Moderate stress: 141, 93.4
- High perceived stress: 8, 5.3

**Systolic blood pressure**
151, 126.5±24.01(80-222)

**Diastolic blood pressure**
151, 81.28±13.56 (54-130)

**Body Mass Index (kg/m²)**
151, 23.81± 4.22 (12.42-38.96)

Table 4.2: Blood pressure category

<table>
<thead>
<tr>
<th>Blood pressure category</th>
<th>Systolic blood pressure n (%)</th>
<th>Diastolic blood pressure n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>68 (45.0)</td>
<td>61 (40.4)</td>
</tr>
<tr>
<td>Elevated</td>
<td>23 (15.2)</td>
<td>15 (9.9)</td>
</tr>
<tr>
<td>Hypertension stage 1</td>
<td>22 (14.6)</td>
<td>30 (19.9)</td>
</tr>
<tr>
<td>Hypertension stage 2</td>
<td>31 (20.5)</td>
<td>43 (28.5)</td>
</tr>
<tr>
<td>Hypertension crisis</td>
<td>7 (4.6)</td>
<td>2 (1.3)</td>
</tr>
</tbody>
</table>
Results from the correlation analysis (Table 4.3) indicate that symptoms related to emotional instability was positively and moderately related to fingernail cortisol (p<0.01), and negatively and marginally related to socioeconomic status (p<0.05), vasosomatic symptoms was negatively and marginally related to household problems (p<0.01) and positively related to fingernail cortisol (p<0.05), aches and pains was negatively related to household problems (p<0.01) and socioeconomic status (p<0.05), mood disturbances was positively correlated to perceived stress. In terms of stress, household problems were positively and moderately correlated to socioeconomic status (p<0.01), perceived stress was negatively and moderately correlated to socioeconomic status (p<0.01), systolic and diastolic blood pressure were positively and moderately correlated to BMI (p<0.01).

In this study, multiple linear regression analysis was conducted to evaluate the relationship between various stressors, including menopausal symptoms, ethnopolitical problems, and household problems, with stress markers such as fingernail cortisol, perceived stress, and blood pressure. The findings presented in Table 4.4 indicate that, after controlling for BMI, SES, and menopausal status, emotional instability (β=0.46, p<0.001) and mood disturbances (β=0.24, p=0.01) were positively associated with fingernail cortisol. Furthermore, household problems were found to be positively associated with fingernail cortisol (β=0.25, p<0.05), whereas no significant association was observed between ethnopolitical problems and any of the stress markers.
### Table 4.3: Correlation between variables of interest

<table>
<thead>
<tr>
<th></th>
<th>Emo</th>
<th>Vaso</th>
<th>Aches</th>
<th>Mood</th>
<th>Ethno</th>
<th>House</th>
<th>SES</th>
<th>BMI</th>
<th>PSS</th>
<th>CORT</th>
<th>SBP</th>
<th>DBP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emo</td>
<td>1</td>
<td>0.71**</td>
<td>0.52**</td>
<td>0.62**</td>
<td>0.05</td>
<td>-0.10</td>
<td>-0.16*</td>
<td>-0.03</td>
<td>0.12</td>
<td>0.27**</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Vaso</td>
<td>0.71**</td>
<td>1</td>
<td>0.41**</td>
<td>0.50**</td>
<td>-0.01</td>
<td>-0.16*</td>
<td>-0.14</td>
<td>-0.07</td>
<td>0.04</td>
<td>0.22*</td>
<td>-0.07</td>
<td>-0.07</td>
</tr>
<tr>
<td>Aches</td>
<td>0.52**</td>
<td>0.41**</td>
<td>1</td>
<td>0.27**</td>
<td>0.07</td>
<td>-0.24**</td>
<td>-0.20*</td>
<td>0.04</td>
<td>0.05</td>
<td>0.02</td>
<td>-0.06</td>
<td>-0.04</td>
</tr>
<tr>
<td>Mood</td>
<td>0.62**</td>
<td>0.50**</td>
<td>0.27**</td>
<td>1</td>
<td>-0.04</td>
<td>-0.14</td>
<td>-0.09</td>
<td>0.03</td>
<td>0.18*</td>
<td>0.04</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Ethno</td>
<td>0.05</td>
<td>-0.01</td>
<td>0.07</td>
<td>-0.04</td>
<td>1</td>
<td>-0.01</td>
<td>-0.05</td>
<td>-0.09</td>
<td>0.12</td>
<td>0.07</td>
<td>0.06</td>
<td>0.08</td>
</tr>
<tr>
<td>House</td>
<td>-0.10</td>
<td>-0.16*</td>
<td>-0.24**</td>
<td>-0.14</td>
<td>-0.01</td>
<td>1</td>
<td>0.33**</td>
<td>-0.06</td>
<td>-0.13</td>
<td>0.17</td>
<td>0.05</td>
<td>0.03</td>
</tr>
<tr>
<td>SES</td>
<td>-0.16*</td>
<td>-0.14</td>
<td>-0.20*</td>
<td>-0.09</td>
<td>-0.05</td>
<td>0.33**</td>
<td>1</td>
<td>0.17*</td>
<td>-0.22**</td>
<td>0.001</td>
<td>-0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>BMI</td>
<td>-0.03</td>
<td>-0.07</td>
<td>0.04</td>
<td>0.03</td>
<td>-0.09</td>
<td>-0.06</td>
<td>0.17*</td>
<td>1</td>
<td>-0.07</td>
<td>-0.13</td>
<td>0.33**</td>
<td>0.36**</td>
</tr>
<tr>
<td>PSS</td>
<td>0.12</td>
<td>0.04</td>
<td>0.05</td>
<td>0.18*</td>
<td>0.12</td>
<td>-0.13</td>
<td>-0.22**</td>
<td>-0.07</td>
<td>1</td>
<td>-0.08</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>CORT</td>
<td>0.27**</td>
<td>0.22*</td>
<td>0.02</td>
<td>0.04</td>
<td>0.07</td>
<td>0.17</td>
<td>0.001</td>
<td>-0.13</td>
<td>-0.08</td>
<td>1</td>
<td>-0.08</td>
<td>-0.14</td>
</tr>
<tr>
<td>SBP</td>
<td>0.01</td>
<td>-0.07</td>
<td>-0.06</td>
<td>0.04</td>
<td>0.06</td>
<td>0.05</td>
<td>-0.01</td>
<td>0.33**</td>
<td>0.05</td>
<td>-0.08</td>
<td>1</td>
<td>0.84**</td>
</tr>
<tr>
<td>DBP</td>
<td>0.01</td>
<td>-0.07</td>
<td>-0.04</td>
<td>0.05</td>
<td>0.08</td>
<td>0.03</td>
<td>0.02</td>
<td>0.36**</td>
<td>0.05</td>
<td>-0.14</td>
<td>0.84**</td>
<td>1</td>
</tr>
</tbody>
</table>

** p<0.01,  * p<0.05

Emo= emotional instability; Vaso=somatic symptoms; Mood= mood disturbances; Aches= Aches and pains; Ethno=Ethnopolitical; House = Household problems; SES= Socioeconomic status; BMI=Body mass index; PSS= Perceived stress scale; CORT= fingernail cortisol; SBP = Systolic blood pressure; DBP= Diastolic blood pressure
### Table 4.4: Multiple linear regression for stress indicators

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Fingernail cortisol</th>
<th>Perceived stress-10</th>
<th>SBP</th>
<th>DBP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β (se) p-value</td>
<td>β (se) p-value</td>
<td>β (se) p-value</td>
<td>β (se) p-value</td>
</tr>
<tr>
<td>Emotional instability&lt;sup&gt;a&lt;/sup&gt;</td>
<td><strong>0.46(0.01)</strong> &lt;0.001</td>
<td>0.28(0.15) 0.07</td>
<td><strong>0.06(1.07)</strong> 0.69</td>
<td><strong>0.02(0.59)</strong> 0.91</td>
</tr>
<tr>
<td>Vaso-somatic symptoms&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.11(0.01) 0.39</td>
<td>0.04(0.14) 0.79</td>
<td>-0.09(0.96) 0.46</td>
<td>-0.04(0.53) 0.74</td>
</tr>
<tr>
<td>Aches and pains&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.10(0.01) 0.33</td>
<td>-0.08(0.18) 0.49</td>
<td>-0.08(1.29) 0.47</td>
<td>-0.04(0.71) 0.72</td>
</tr>
<tr>
<td>Mood disturbances&lt;sup&gt;a&lt;/sup&gt;</td>
<td><strong>0.24(0.02)</strong> 0.03</td>
<td>0.00(0.27) 0.98</td>
<td><strong>0.08(1.92)</strong> 0.45</td>
<td><strong>0.09(1.06)</strong> 0.40</td>
</tr>
<tr>
<td>Ethnopolitical problems</td>
<td>0.06(0.02) 0.51</td>
<td>0.03(0.24) 0.77</td>
<td><strong>0.07(1.71)</strong> 0.43</td>
<td><strong>0.08(0.94)</strong> 0.35</td>
</tr>
<tr>
<td>Household problems</td>
<td><strong>0.25(0.02)</strong> 0.01</td>
<td>0.12(0.40) 0.25</td>
<td><strong>0.39(0.53)</strong> &lt;0.001</td>
<td><strong>0.42(0.29)</strong> &lt;0.001</td>
</tr>
<tr>
<td>BMI</td>
<td>-0.08(0.00) 0.38</td>
<td>-0.13(0.07) 0.17</td>
<td><strong>0.39(0.53)</strong> &lt;0.001</td>
<td><strong>0.42(0.29)</strong> &lt;0.001</td>
</tr>
<tr>
<td>SES</td>
<td>-0.02(0.00) 0.85</td>
<td>-0.11(0.05) 0.29</td>
<td>-0.11(0.33) 0.25</td>
<td>-0.08(0.18) 0.43</td>
</tr>
<tr>
<td>Premenopause</td>
<td><strong>0.27(0.04)</strong> 0.01</td>
<td>-0.03(0.72) 0.77</td>
<td><strong>0.21(5.05)</strong> 0.04</td>
<td>-0.19(2.79) 0.06</td>
</tr>
<tr>
<td>Perimenopause</td>
<td>0.01(0.06) 0.94</td>
<td>0.03(1.00) 0.78</td>
<td>-0.01(7.07) 0.89</td>
<td>-0.01(3.91) 0.93</td>
</tr>
</tbody>
</table>

**Observations**: 119 119 119 119 119 119 119
**Multiple R-squared**: 0.17 0.14 0.18 0.19

Standard errors in parentheses; *symptom groupings from factor analysis; emotional instability 0-24 points; Vaso-somatic symptoms 0-21 points; mood disturbances 0-15 points; Aches and pains 0-15 points; ethnopolitical problems 0-9; household problems 0-3; All variables are mutually adjusted. Significant results are bolded.
The findings presented in Table 4.5 indicated that higher household problems (OR:1.77; 95% CI:1.030-3.049) and BMI (OR:1.28; 95%CI:1.131-1.453) were associated with an increased risk of developing hypertension based on systolic blood pressure. Moreover, a higher BMI (OR:1.24; 95%CI:1.102-1.398) was also found to be a risk factor for hypertension based on diastolic blood pressure readings.

Table 4.5: Logistic regression for blood pressure (SBP >120 and DBP >80) and stressors

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>SBP</th>
<th></th>
<th>DBP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95%CI</td>
<td>OR</td>
<td>95%CI</td>
</tr>
<tr>
<td>Emotional instability</td>
<td>1.08</td>
<td>0.89-1.31</td>
<td>1.02</td>
<td>0.83-1.25</td>
</tr>
<tr>
<td>Vaso-somatic symptoms</td>
<td>0.92</td>
<td>0.77-1.11</td>
<td>1.06</td>
<td>0.88-1.28</td>
</tr>
<tr>
<td>Aches and pains</td>
<td>0.92</td>
<td>0.71-1.20</td>
<td>0.93</td>
<td>0.70-1.23</td>
</tr>
<tr>
<td>Mood disturbances</td>
<td>1.11</td>
<td>0.77-1.61</td>
<td>0.96</td>
<td>0.64-1.44</td>
</tr>
<tr>
<td>Ethmnopitical problems</td>
<td>1.20</td>
<td>0.86-1.68</td>
<td>1.04</td>
<td>0.73-1.47</td>
</tr>
<tr>
<td>Household problems</td>
<td>1.77</td>
<td><strong>1.03-3.04</strong></td>
<td>1.43</td>
<td>0.82-2.47</td>
</tr>
<tr>
<td>BMI</td>
<td><strong>1.28</strong></td>
<td><strong>1.13-1.45</strong></td>
<td><strong>1.24</strong></td>
<td><strong>1.10-1.39</strong></td>
</tr>
<tr>
<td>SES</td>
<td>0.94</td>
<td>1.13-1.45</td>
<td>0.96</td>
<td>0.90-1.03</td>
</tr>
</tbody>
</table>

All variables were mutually adjusted. Significant results are bolded.

A word cloud technique was employed to analyze the responses provided by the participants when asked about the factors that induced stress (Figure 10). The results revealed that the term “future” was the most frequently mentioned response, followed by “well-being,” “health,” and “financial.” Terms such as “alcoholism” and “spouse” were also frequently mentioned. The word “future” was found to be closely linked to concerns related to the future of participants’ children.
Interviews where participants provided accounts of the sources of stress that affected them.

Really, it’s not about me but my youngest son, once upon a time, [he] started mingling with bad [alcoholic] friends and started drinking and going crazy. He doesn’t fight at home but if he meets good friends [non-alcoholics] his mannerisms are fine but when he meets bad friends, he gets influenced so that is my biggest problem. When that happens, I feel like dying. Life has ups and downs so I often think about how my children would live, and what will their future be like. That’s what worries me. That’s all.

Another instance of a participant narrating what stresses her:

My health is not normal [laughs]. I always get sick. I have been undergoing treatment [medical] for quite some time now. Since my kidneys are not good, I
often have problems… I have kidney stones… Since 2009, I had treatment, taken medication… I don’t want to operate and also since I have financial problems. He [doctor] told me to go to Guwahati to take it out but I was like, God’s creation is good so as a human even if it's difficult it’s better to take ayurvedic medicine. After 3 months of ayurvedic medication and washing out the kidneys, it was the same so I decided to let it be God’s will. I thought I will not ruin God’s creation; I will just take ayurvedic medicine. So, since 2009 I’m just staying like this. When I have kidney pain, I cannot stand up because of back pain. I also have fevers. If I have a high fever, my throat swells up and I cannot talk. At least for 3 days, I cannot talk but it gets normal after using ayurvedic medicine and hot water. This is my biggest problem.

**Discussion and Conclusion**

In this study, the association between various stressors and stress markers, namely chronic stress measured by fingernail cortisol, perceived stress measured by PSS-10, and acute stress measured by blood pressure were examined. Results indicate a significant positive association between household stress, the emotional instability factor, and mood disturbances factor, as evidenced by fingernail cortisol. Notably, this association remained significant even after adjusting for BMI, SES, and menopausal status, which are important confounding factors in stress research (e.g., Baum et al. 1999; Foss & Dyrstad, 2011). This finding suggests that domestic issues, such as worries about children and health, conflict with family members, or financial strain, can contribute to the physiological stress response that may have long-term health consequences.
Numerous studies have indicated a significant association between stress (cortisol levels and perceived stress) and menopausal symptoms (Cagnacci et al. 2011, 2022; Gibson et al. 2016; Gold et al. 2004; Knight et al. 2010; Sievert et al. 2018; Woods et al. 2006). In a recent investigation examining the potential relationship between symptoms of menopause and cortisol response, as evaluated by 24-hour urine free cortisol levels (24h UFC), a significant correlation between 24 h UFC levels and Greene climacteric scores at baseline was observed. Moreover, independent associations between 24h UFC levels and subscores related to depression, anxiety, and somatization were established, while vasomotor symptoms and sexual dysfunction were not found to be statistically associated (Cagnacci et al. 2022). My study’s results are consistent with these findings, as a significant association between fingernail cortisol levels and emotional instability (which encompasses variables related to depression, anxiety, and somatization in the Greene Climacteric Scale) was observed.

In Northern California, older women (aged 40-50), who reported having lower income, higher overall stress perception, a negative attitude towards aging, and a positive attitude towards menopause had more intense menopausal symptoms at 12-month follow-up (Nosek et al. 2010). Yu and Ho (2010) conducted a study that demonstrated a significant relationship between perceived stress scores, measured by PSS-10, and the number of menopausal symptoms across all five symptom groups. Specifically, higher PSS scores were linked to a greater presence of psychological symptoms (r=0.406, p<0.01), and to a lesser degree musculoskeletal and gastrointestinal (r=0.219, p<0.01), non-specific somatic complaints (r=0.231, p<0.01), respiratory (r=0.180, p<0.01), and vasomotor symptoms (r=0.235, p<0.01). The authors also reported that these associations
were not significantly affected by adjusting for age. Consistent with their findings for psychological symptoms, this study also indicated an association between perceived stress and emotional instability. However, this study did not find an association with the other factors identified: vaso-somatic symptoms, mood disturbances, or aches and pains.

In this study, blood pressure was significantly associated with BMI but not any specific stressors, suggesting that BMI may be an important factor to consider when studying the effects of stress on blood pressure (Cifkova et al. 2008; Drøyvold et al. 2005).

Contrary to prior research, this study did not document a significant association between ethnopolitical problems and stress markers (e.g., González-Castro et al. 2021; Zagefka & Jamir, 2015). This suggests that other factors, such as household stressors, might play a larger role in determining how participants perceive and respond to stress. Results from the word cloud also suggested that participants had strong concerns about the overall well-being and health of their families, including the possible impact of alcoholism. The word “future” was most frequently mentioned, with many participants expressing concerns about their children’s future due to limited job prospects, lack of family income, or retirement (self or spouse). The fact that health was mentioned as a separate category from well-being suggests that participants may be particularly worried about specific health issues or conditions that may have a direct impact on their daily lives. Moreover, participants expressed particular concern over alcohol use by family members (i.e., spouses and sons), whose behavior occasionally resulted in property damage, abuse, and infidelity.
Another reason for the lack of association between ethnopolitical problems and stress markers may be attributed to the consistently high level of stress levels experienced by women in Nagaland. It is possible that the perceived variation in this type of stress is low. In such cases, individuals may not perceive the stress in the same way as people from other regions, making it a challenge in identifying a reliable biological marker of stress due to the limited perceived variation in stress levels.

This study is subject to a few limitations. First, the generalizability of my research may be limited due to the specific nature of the stressors that were examined in this study. Therefore, the findings of this study may not be extended to other contexts or stressors that were not included in the study. Furthermore, this study relied on self-reported measures of stress (household stressor and ethnopolitical stressor), which may be subject to social desirability biases and may not accurately reflect the actual stress levels experienced by participants.

Overall, this study highlights the importance of considering multiple sources of stress when assessing their impact on emotional and physiological well-being. The implications of these findings provide valuable insights into the specific stressors that may be particularly salient for the Naga population and underscore the importance of accounting for multiple sources of stress in stress research. More importantly, these findings will help to inform the development of tailored interventions to address the unique needs of this population in order to improve their overall well-being.
CHAPTER 5

CHRONIC STRESS, SOCIAL SUPPORT, AND SYMPTOMS AT MIDLIFE. IS THERE A BUFFERING EFFECT?

Introduction

Menopause is the permanent cessation of menstruation resulting from the loss of follicular activity in the ovaries (WHO, 1996). It marks the end of women’s reproductive life and the beginning of post-reproductive life. Menopause is identified in retrospect after 12 months of amenorrhea. In the US, on average, women undergo menopause at 52.5 (Gold et al. 2013), but averages can vary from 49 to 53 years (Henderson et al. 2008; Morabia et al. 1998; Nichols et al. 2006; Sievert et al. 2013). In India, the mean age of menopause is lower and varies from 44 to 49 years (Dasgupta & Ray, 2009; Singh & Sivakami, 2020; Sharma, 2019).

Most women experience physiological, psychological, and social changes while navigating the menopausal years. This menopausal transition can be accompanied by a wide array of symptoms that can be bothersome and can last for up to 10 years or more after menopause (Avis et al. 2015; Hamoda et al. 2020; Hunter et al. 2012). These symptoms may include mood changes, hot flashes, sleeplessness, anxiety, cognitive changes, and difficulty in concentrating. Moreover, menopausal symptoms can vary widely across populations, ethnicities, and individuals (Arnot et al. 2021; Melby and Lampl, 2011; Obermeyer, 2000; Sievert, 2006, Syamala and Sivakami, 2005), as is the case across the Indian subcontinent (Deotal et al. 2015; Sharma et al. 2007).

The wide variation in symptom experience has been associated with perception or attitudes toward menopause, social support, and stress, among other factors (Bauld &
Brown, 2009; Hafiz et al. 2007; Sievert & Espinosa-Hernandez, 2003; Zhao et al. 2019). Studies have shown that social support is associated with the overall health and well-being of an individual (Albrecht and Goldsmith, 2003; Brown et al. 2003; Cohen et al. 2000; Raffaelli et al. 2013); however, the explicit nature of the positive influence of social support remains elusive (Pahl, 2003). Social support was associated with a reduced frequency of menopausal symptoms in Turkey and China (Polat et al. 2021; Zhao et al. 2019). However, some studies have shown no relationship between social support and menopausal symptoms (Arnot et al. 2021; Blümel et al. 2004). These inconsistencies may be in part due to cultural differences, perceptions of social support, and the multifaceted nature of social support itself (e.g., support from spouse, family, and friends). Thus, the direct or buffering effect of social support on symptom outcomes needs to be studied within specific cultural contexts and as a multidimensional component (e.g., support from spouse, family, and friends), which is the goal of this paper.

Stress is an important indicator of several health morbidities. Stress can be measured by biomarkers (e.g., cortisol, dehydroepiandrosterone sulfate) or with a questionnaire (e.g., the perceived stress scale, Cohen, 1988; Cohen et al. 1983). An increase in cortisol secretion due to stress can be adaptive in the short term; however, excessive cortisol secretion over time may have adverse effects, physically and mentally (Heim et al. 2000; Jankord & Herman, 2008). Cortisol, when used as a stress biomarker in relation to menopausal symptoms, has traditionally been measured in saliva (Gerber et al. 2017; Patacchioli et al. 2006), urine (Cagnacci et al. 2022; Woods et al. 2006), or blood samples (Katainen et al. 2018), with inconsistent findings (Cray et al. 2010; Woods et al. 2006; Gerber et al. 2017). Moreover, cortisol concentrations from saliva, blood, and urine
inform a relatively short time frame (at most a few days) and require repeated measurements across 24 hours over several days to obtain average chronic concentrations (Wosu et al. 2013). These methods can be expensive and can lack feasibility for measuring individuals in more remote areas. On the other hand, nail cortisol is a non-invasive, culturally appropriate, and cost-efficient alternative. Nail cortisol represents an accumulation of cortisol output over a time frame of months and thus has been used as a measure to characterize chronic stress (Jankovic-Rankovic et al. 2020). In this study, fingernail cortisol levels were examined to assess the level of stress among individuals within the community of Nagaland, India. To the best of my knowledge, this is the first study of fingernail cortisol in relation to symptoms at midlife carried out in India. Furthermore, the timeline for collecting the data (January 2021-June 2021) provides an unfortunate but ideal scenario for capturing chronic stress induced by the burden of COVID-19. The highest average number of COVID cases and deaths in India was in May 2021 (NYT, 2022).

Thus, the present study aims to investigate the relationship between social support, stress, and symptom severity among women in Nagaland, India. I hypothesized that women who have higher social support would have less severe symptoms at midlife. I further hypothesized that social support would have a buffering effect against chronic stress measured by fingernail cortisol and day-to-day stress measured by the perceived stress scale. Relevant excerpts pertaining to the concept of social support were also used to provide contextual support.
Methods

Study design and participants

The cross-sectional study (n=151) was conducted in Nagaland, India from January 2021 to July 2021. Opportunity samples were obtained from 4 regions (Kohima, Dimapur, Mima, and Shaki) in Nagaland. Participants were recruited with the help of key informants - a socially well-connected person located in the same geographic vicinity as the participants. The following were exclusion criteria: non-tribal populations, pregnant/lactating women, those who underwent hysterectomies, and those using hormone therapy. Due to the timing of the data collection coinciding with the COVID-19 Delta variant outbreak in India, strict safety protocols were followed, and appropriate passes to visit each community were sought from the concerned authorities. No positive COVID-19 reports were recorded among the study participants during the time of data collection. Informed signed consent was sought from all participants prior to the start of the interviews. The study was approved by the Institutional Review Board, University of Massachusetts, Amherst.

Menopause status and symptoms

Menopause stages were defined using the STRAW+10 categories (Harlow et al. 2012). Based on the menstrual pattern, participants were divided into premenopausal: no changes, heavier/lighter menses, or subtle changes in the cycle length; perimenopausal: menstrual cycle changes of more than 6 days or an interval of amenorrhea of 2 or more months; or postmenopausal: no period for 12 months or more.

Menopause symptoms were assessed using the Greene Climacteric Scale (GCS; Greene, 1976). This scale has been often used in India (Kaur & Kaur, 2022) and measures
the frequency and severity of various menopausal symptoms experienced within the last 2 weeks. The scale consists of 21 symptoms rated on a scale from 0 (not at all) to 3 (extremely). All symptoms were analyzed using exploratory factor analysis to determine symptom subgroups. Based on the analysis, 4 symptom subgroups were identified (emotional instability, vaso-somatic symptoms, mood disturbance, and aches and pains). The four factors explained 43.8% of the total symptom variance in the population.

**Markers of stress**

Chronic stress was measured with fingernail cortisol. Participants were asked to clip their nails with a nail clipper directly into a Ziploc bag or onto a piece of white paper to ensure that no clippings were lost. Participants whose nails were not long enough to be clipped during the time of the interview were given a Ziploc bag and asked to clip their nails after 3 weeks or more, depending on the growth of their nails. Out of 122 participants, 9 participants had nail polish use. For all participants, the date of clippings was recorded along with the date of the interview.

Each Ziploc bag containing an individual sample was labeled by the participant’s ID and stored at room temperature away from direct sunlight. The fingernail samples were then transported to Dr. Jerrold Meyer’s laboratory in the Department of Psychological and Brain Sciences at the University of Massachusetts Amherst. The fingernail samples were analyzed for fingernail cortisol (pg/mg) using the Arbor Assays (Ann Arbor, MI) DetectX enzyme immunoassay kit (#K003–H1) employing the procedures described in the paper by Jankovic-Rankovic et al. (2020).

Perceived stress was collected with the help of the 10-item Perceived Stress Scale (PSS-10, Cohen, 1988; Cohen et al. 1983). The PSS measures the degree to which situations in
one’s life during the past month are considered stressful. For instance, participants were asked how often they felt nervous and stressed, and how often they felt that things were not going their way. Each question was answered on a Likert scale ranging from 0 to 4. Individual scores on the PSS can range from 0 to 40 with higher final scores indicating higher perceived stress. The total scores were categorized into 3 groups namely, low stress (0-13); moderate stress (14-26); and high perceived stress (27-40). The PSS is an important measure of one’s perception of an event, as the same event (e.g., menopause or COVID-19) can be perceived differently by different individuals.

**Perceived social support**

The Multidimensional Scale of Perceived Social Support (MSPSS) was administered to measure the level of social support received by women (Zimet et al. 1988). The MSPSS is a brief 12-item, self-administered measurement tool and includes statements such as, there is a special person who is around when I am in need, my friends try to help me, and my family is willing to help me make decisions. These questions were divided into three subscales based on four questions each for family, friends, and significant others with answers on a seven-point Likert scale ranging from 1 (very strongly disagree) to 7 (very strongly agree). The scale scores for the MSPSS can range from 12 to 84, with higher scores indicating greater perceived social support. The scale has been validated and used in the Indian population (Kwan et al. 2016). In this study, Cronbach’s alpha value was 0.85. A factor analysis was performed for social support to verify the reliability of the multidimensional aspect of social support (Table 5.4). Based on the factor loadings 3 sources of support (spouse, family, and friends) to capture the multi-dimensionality of support received in this population were used.
An open-ended question on social support was employed to elicit responses to the question, “When faced with a problem, whom do you depend on for support and assistance?” The participant’s preferred sources of social support during times of personal difficulties were recorded with the help of an audio recorder and translated from Nagamese or Lotha dialects to English. These excerpts were used to provide contextual support to the study.

**Sociodemographic variables**

A general questionnaire was administered to obtain sociodemographic information such as age, age at menopause, socioeconomic status, and tobacco use. Anthropometric measures of height to the nearest 0.1 cm and weight to the nearest 0.1 kg were collected using an anthropometer rod and an analog weighing scale, respectively. Body mass index (BMI) was derived as weight in kilograms divided by height in meters squared. Thirteen community-specific socio-economic variables were queried, including occupation, income, education, number of children, employment of household helpers, and possession of cars and houses. Participant responses were summed to obtain a total socioeconomic score ranging from 0-62. A higher score indicates better socio-economic status.

**Statistical analysis**

Data analysis was conducted using STATA version 14 (College Station, TX, USA). Continuous variables such as age, recalled age at menopause, and BMI were presented as mean, standard deviation, and range. Categorical variables such as tobacco use, education, and menopausal status were presented as frequencies and percentages. In the regression model, women with missing exposure and outcome variables (n=119) were excluded. Multiple linear regression models were used to determine the relationship between
menopausal symptoms, stressors, and social support, controlling for menopause status, socioeconomic status, BMI, and tobacco use. The base model indicates the relationship between stress, social support, and symptom severity controlling for covariates. Interactions between social support (spouse, family, and friends) and stress (PSS and fingernail cortisol) were examined to measure the degree to which social support buffered stress. Furthermore, using the mean values of social support (spouse, family, and friends) as the cutoff points, social support was stratified into low and high support, and multiple regressions were performed to observe the relationships (Table 5.5-5.10).

**Results**

Women on average were aged 44.1 years. Out of 151 participants, 51 participants had undergone menopause and had a mean recalled age at natural menopause of 47 years. About 41% of women had obtained less than a high school degree, 46% were homemakers, 80% were married, and 26% chewed tobacco (Table 5.1). Based on the Asian cut-off for BMI (WHO, 2000), women on average were overweight (mean BMI 23.8 kg/m²). Almost all (93%) women reported having moderate stress. MSPSS total mean scores were found to be 12.74±5.35 for spousal support, 13.21±5.90 for family support, 10.84±5.01 for support from friends, and 40.64±12.33 for overall support.
Table 5.1: Descriptive statistics

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>% or mean ± SD (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>151</td>
<td>44.1± 5.13 (40-55)</td>
</tr>
<tr>
<td><strong>Age at menopause (years)</strong></td>
<td>51</td>
<td>47.0± 3.38 (35-53)</td>
</tr>
<tr>
<td><strong>Socioeconomic status index</strong></td>
<td>151</td>
<td>35.9±7.57 (22-56)</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homemaker</td>
<td>69</td>
<td>45.7</td>
</tr>
<tr>
<td>Farmer</td>
<td>48</td>
<td>31.8</td>
</tr>
<tr>
<td>Public/private sector worker</td>
<td>34</td>
<td>22.5</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>35</td>
<td>23.2</td>
</tr>
<tr>
<td>Less than high school</td>
<td>62</td>
<td>41.0</td>
</tr>
<tr>
<td>High school degree</td>
<td>38</td>
<td>25.2</td>
</tr>
<tr>
<td>College degree or higher</td>
<td>16</td>
<td>10.6</td>
</tr>
<tr>
<td><strong>Tobacco use</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>39</td>
<td>25.8</td>
</tr>
<tr>
<td>No</td>
<td>112</td>
<td>74.2</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>112</td>
<td>80.8</td>
</tr>
<tr>
<td>Widowed</td>
<td>15</td>
<td>9.9</td>
</tr>
<tr>
<td>Divorced</td>
<td>11</td>
<td>7.3</td>
</tr>
<tr>
<td>Never married</td>
<td>3</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Menopause status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Premenopause</td>
<td>79</td>
<td>52.3</td>
</tr>
<tr>
<td>Perimenopause</td>
<td>21</td>
<td>13.9</td>
</tr>
<tr>
<td>Postmenopause</td>
<td>51</td>
<td>33.8</td>
</tr>
<tr>
<td><strong>Fingernail cortisol (log10)</strong></td>
<td>119</td>
<td>0.37± 0.22 (-0.40-0.88)</td>
</tr>
<tr>
<td><strong>Perceived Stress Scale-10</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low stress</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>Moderate stress</td>
<td>141</td>
<td>93.4</td>
</tr>
<tr>
<td>High perceived stress</td>
<td>8</td>
<td>5.3</td>
</tr>
<tr>
<td><strong>Multi-dimensional social support (1-7 points)</strong></td>
<td>151</td>
<td>40.64±12.33(12-66)</td>
</tr>
<tr>
<td>Spouse</td>
<td>151</td>
<td>12.74±5.35 (4-24)</td>
</tr>
<tr>
<td>Family</td>
<td>151</td>
<td>13.21±5.90 (4-24)</td>
</tr>
<tr>
<td>Friends</td>
<td>151</td>
<td>10.84±5.01 (4-24)</td>
</tr>
<tr>
<td><strong>Body Mass Index (kg/m²)</strong></td>
<td>151</td>
<td>23.81± 4.22 (12.42-38.96)</td>
</tr>
</tbody>
</table>
In this study, chronic stress (fingernail cortisol) and perceived stress were found to be significantly and positively associated with emotional instability score (p<0.01) and total symptom score (p<0.05) (Table 5.2). In addition, perceived stress was significantly and positively associated with emotional instability score (p<0.01), vaso-somatic symptom score (p<0.01), and total symptom score (p<0.01). A significant negative correlation was found between family support and all symptoms; however, only aches and pains showed a significant negative correlation with spousal support. Significant negative (p<0.05) associations were also observed for family support with fingernail cortisol and perceived stress scores.
Table 5.2: Correlations between continuous variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Emo</th>
<th>Vaso</th>
<th>Mood</th>
<th>Aches</th>
<th>GCS</th>
<th>CORT</th>
<th>PSS</th>
<th>SP</th>
<th>FA</th>
<th>FR</th>
<th>BMI</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emo</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaso</td>
<td>0.710**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mood</td>
<td>0.628**</td>
<td>0.505**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aches</td>
<td>0.523**</td>
<td>0.418**</td>
<td>0.275**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GCS</td>
<td>0.923**</td>
<td>0.870**</td>
<td>0.709**</td>
<td>0.656**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CORT</td>
<td>0.279**</td>
<td>0.222*</td>
<td>0.047</td>
<td>0.029</td>
<td>0.218*</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSS</td>
<td>0.267**</td>
<td>0.228**</td>
<td>0.135</td>
<td>0.076</td>
<td>0.240**</td>
<td>0.242**</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td>-0.033</td>
<td>-0.132</td>
<td>-0.124</td>
<td>-0.188*</td>
<td>-0.132</td>
<td>-0.135</td>
<td>-0.038</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FA</td>
<td>-0.248**</td>
<td>-0.219**</td>
<td>-0.192*</td>
<td>-0.219**</td>
<td>-0.273**</td>
<td>-0.185*</td>
<td>-0.164*</td>
<td>0.533**</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FR</td>
<td>-0.034</td>
<td>-0.058</td>
<td>-0.155</td>
<td>-0.071</td>
<td>-0.083</td>
<td>0.148</td>
<td>-0.080</td>
<td>0.130</td>
<td>0.122</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>-0.039</td>
<td>-0.072</td>
<td>0.039</td>
<td>0.043</td>
<td>-0.026</td>
<td>-0.139</td>
<td>-0.145</td>
<td>0.002</td>
<td>0.112</td>
<td>0.211**</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>-0.165*</td>
<td>-0.145</td>
<td>-0.099</td>
<td>-0.203*</td>
<td>-0.189*</td>
<td>0.001</td>
<td>-0.146</td>
<td>-0.012</td>
<td>0.059</td>
<td>0.205*</td>
<td>0.178*</td>
<td>1.000</td>
</tr>
</tbody>
</table>

** p<0.01, * p<0.05

Emo= emotional instability; Vaso= Vaso-somatic symptoms; Mood = mood disturbances; Aches= Aches and pains; GCS = total midlife symptoms; CORT= fingernail cortisol; PSS= Perceived stress scale; SP = spousal support; FA= Family support; FR = Friends’ support; BMI=Body mass index; SES= Socioeconomic status
Multiple linear regression was used to analyze symptom severity (Table 5.3). After controlling for menopause status, socioeconomic status, BMI, and tobacco use, the base model indicated that: (a) fingernail cortisol was positively and significantly associated with emotional instability ($\beta =0.26$, $p<0.01$), vaso-somatic symptom score ($\beta =0.19$, $p=0.05$), and total symptoms ($\beta =0.19$, $p=0.05$), (b) total social support was negatively and significantly associated with mood disturbances ($\beta =-0.21$, $p<0.001$), aches and pains ($\beta =-0.26$, $p<0.001$), and total symptoms ($\beta =-0.21$, $p<0.05$), and (c) family support was negatively and significantly associated with emotional instability ($\beta =-0.22$, $p<0.05$) and total symptom score ($\beta =-0.20$, $p=0.05$). Perimenopausal status was positively and significantly associated with aches and pains ($\beta =0.20$, $p<0.05$). Socioeconomic status was significantly and negatively associated with aches and pains ($\beta =-0.35$, $p<0.001$) and total symptom score ($\beta =-0.20$, $p<0.05$). Perceived stress was not associated with any symptoms.
Table 5.3: Base model measuring symptom severity using multiple linear regression.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Emotional instability</th>
<th>Vaso-somatic symptoms</th>
<th>Mood disturbances</th>
<th>Aches and pains</th>
<th>Total symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$ (S.E)</td>
<td>p-value</td>
<td>$\beta$ (S.E)</td>
<td>p-value</td>
<td>$\beta$ (S.E)</td>
</tr>
<tr>
<td>Fingernail cortisol</td>
<td>0.26 (1.36)</td>
<td>0.01</td>
<td>0.19 (1.43)</td>
<td>0.05</td>
<td>-0.01 (0.64)</td>
</tr>
<tr>
<td>Perceived stress scale</td>
<td>0.16 (0.09)</td>
<td>0.08</td>
<td>0.13 (0.09)</td>
<td>0.19</td>
<td>0.12 (0.04)</td>
</tr>
<tr>
<td>Total social support</td>
<td>-0.12 (0.02)</td>
<td>0.16</td>
<td>-0.15 (0.02)</td>
<td>0.09</td>
<td>-0.21 (0.01)</td>
</tr>
<tr>
<td>Support from spouse</td>
<td>0.13 (0.06)</td>
<td>0.17</td>
<td>-0.02 (0.06)</td>
<td>0.85</td>
<td>-0.01 (0.03)</td>
</tr>
<tr>
<td>Support from Family</td>
<td>-0.22 (0.06)</td>
<td>0.03</td>
<td>-0.09 (0.06)</td>
<td>0.42</td>
<td>-0.19 (0.03)</td>
</tr>
<tr>
<td>Support from Friends</td>
<td>-0.09 (0.05)</td>
<td>0.31</td>
<td>-0.13 (0.05)</td>
<td>0.19</td>
<td>-0.09 (0.02)</td>
</tr>
<tr>
<td>Premenopause</td>
<td>-0.15 (0.67)</td>
<td>0.14</td>
<td>-0.04 (0.70)</td>
<td>0.72</td>
<td>0.10 (0.31)</td>
</tr>
<tr>
<td>Perimenopause</td>
<td>0.10 (0.92)</td>
<td>0.31</td>
<td>0.13 (0.97)</td>
<td>0.20</td>
<td>0.11 (0.43)</td>
</tr>
<tr>
<td>BMI</td>
<td>0.02 (0.07)</td>
<td>0.84</td>
<td>-0.06 (0.07)</td>
<td>0.51</td>
<td>0.00 (0.03)</td>
</tr>
<tr>
<td>Tobacco use</td>
<td>-0.06 (0.66)</td>
<td>0.53</td>
<td>-0.01 (0.69)</td>
<td>0.88</td>
<td>-0.19 (0.31)</td>
</tr>
<tr>
<td>SES</td>
<td>-0.16 (0.04)</td>
<td>0.07</td>
<td>-0.10 (0.04)</td>
<td>0.28</td>
<td>-0.04 (0.02)</td>
</tr>
</tbody>
</table>

Observations: 119 | R-squared: 0.26

Standard errors in parentheses; emotional instability 0-24 points; Vaso-somatic symptoms 0-21 points; mood disturbances 0-15 points; Aches and pains 0-15 points; total symptoms 0-63 points; All variables are mutually adjusted. Significant results are bolded.
After controlling for menopause status, socioeconomic status, BMI, and tobacco use, the interaction models for fingernail cortisol levels and total social support and support from spouse, family, friends, and between perceived stress and total social support and support from spouse, family, and friends were found to be non-significant (Table not shown). These interactions were used to test whether social support, total and support from spouse, family, and friends modified (i.e., buffered) the effect of stress.

To further examine the impact of social support on symptoms at midlife and stress, social support was stratified as high and low support using the means (Tables 5.5-5.10), and regression analysis was performed. In Tables 5.5 and 5.6, perceived stress and vaso-somatic symptoms indicate an interaction (high spouse support $\beta=0.01$, $p=0.97$ vs low spouse support $\beta=0.26$, $p=0.05$).

Participants’ perceptions of the concept of social support were variable. For instance, when asked, “When faced with a problem, whom do you depend on for support and assistance?”, participants’ responses ranged from high support from their spouse, families, and friends to no support at all. Excerpts from the interviews are presented below to illustrate such differences.

Excerpt 1: “If I have a problem, we're on Earth, so I have problems. Even with my spouse and myself, I have many problems, but I do not tell anyone. With God, it may be 1 hour or 2 hours or 30 minutes, I kneel down and pray saying, "Instead of relying on people, it's better to rely on you, God. I am leaving everything unto you." I only relay it to God but no one else.”
Excerpt 2: “I rely on my spouse. Unlike other people, I do not have family here, so when I need to talk about my problems, I turn to my children, specifically my daughter.”

Excerpt 3: "I usually tell my friends. I am open, you know, so I tell them when we meet and gossip…. My parents passed away and my sisters have their own family to worry about, so I tell my colony friends. They know everything. I think I talk a lot, so people think I do not care about anything, but being like this makes me happy."
Table 5.4: Factor loading for social support

<table>
<thead>
<tr>
<th>Variables</th>
<th>Factor1: Friends</th>
<th>Factor2: Spouse</th>
<th>Factor3: Family</th>
<th>Uniqueness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have friends to share joys and sorrows</td>
<td>0.9555</td>
<td>0.0599</td>
<td>-0.0148</td>
<td>0.0831</td>
</tr>
<tr>
<td>Receives help from friends</td>
<td>0.9517</td>
<td>0.024</td>
<td>0.078</td>
<td>0.0877</td>
</tr>
<tr>
<td>Can depend on friends</td>
<td>0.9497</td>
<td>-0.0029</td>
<td>0.078</td>
<td>0.092</td>
</tr>
<tr>
<td>Can share problems with friends</td>
<td>0.9064</td>
<td>0.1096</td>
<td>0.025</td>
<td>0.1657</td>
</tr>
<tr>
<td>There is a special person around when in need</td>
<td>0.0206</td>
<td>0.8446</td>
<td>0.2466</td>
<td>0.2254</td>
</tr>
<tr>
<td>There is a special person as a source of comfort</td>
<td>0.0221</td>
<td>0.8369</td>
<td>0.2853</td>
<td>0.2177</td>
</tr>
<tr>
<td>There is a special person to share joys and sorrows</td>
<td>0.0695</td>
<td>0.8335</td>
<td>0.1891</td>
<td>0.2647</td>
</tr>
<tr>
<td>There is a special person who cares about feelings</td>
<td>0.1278</td>
<td>0.7894</td>
<td>0.1627</td>
<td>0.3339</td>
</tr>
<tr>
<td>Can share problems with family</td>
<td>0.0881</td>
<td>0.2479</td>
<td>0.815</td>
<td>0.2666</td>
</tr>
<tr>
<td>Receives emotional support from family</td>
<td>0.0616</td>
<td>0.2487</td>
<td>0.7975</td>
<td>0.2984</td>
</tr>
<tr>
<td>Receives help from family</td>
<td>0.0455</td>
<td>0.2962</td>
<td>0.7966</td>
<td>0.2756</td>
</tr>
<tr>
<td>Receives help from family to make decisions</td>
<td>0.0216</td>
<td>0.1708</td>
<td>0.7184</td>
<td>0.4542</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax
Table 5.5: Multiple linear regression model with high spousal support

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Emotional instability</th>
<th>Vaso-somatic symptoms</th>
<th>Mood disturbances</th>
<th>Aches and pains</th>
<th>All symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>SE</td>
<td>p-value</td>
<td>β</td>
<td>SE</td>
</tr>
<tr>
<td>Fingernail cortisol</td>
<td>0.25</td>
<td>(2.03)</td>
<td>0.07</td>
<td>0.10</td>
<td>(2.09)</td>
</tr>
<tr>
<td>Perceived stress</td>
<td>0.09</td>
<td>(0.14)</td>
<td>0.50</td>
<td>-0.01</td>
<td>(0.14)</td>
</tr>
<tr>
<td>Premenopause</td>
<td>-0.13</td>
<td>(1.01)</td>
<td>0.39</td>
<td>-0.03</td>
<td>(1.04)</td>
</tr>
<tr>
<td>Perimenopause</td>
<td>0.19</td>
<td>(1.46)</td>
<td>0.18</td>
<td>0.21</td>
<td>(1.51)</td>
</tr>
<tr>
<td>BMI</td>
<td>-0.06</td>
<td>(0.13)</td>
<td>0.65</td>
<td>-0.17</td>
<td>(0.14)</td>
</tr>
<tr>
<td>tobacco</td>
<td>-0.21</td>
<td>(1.06)</td>
<td>0.15</td>
<td>-0.01</td>
<td>(1.10)</td>
</tr>
<tr>
<td>SES</td>
<td>-0.05</td>
<td>(0.06)</td>
<td>0.71</td>
<td>-0.03</td>
<td>(0.06)</td>
</tr>
</tbody>
</table>

Observations | 56 | 56 | 56 | 56 | 56 | 56 |
R-squared | 0.23 | 0.04 | 0.18 | 0.06 | 0.10 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05
Table 5.6: Multiple linear regression model with low spousal support

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Emotional instability</th>
<th>Vaso-somatic symptoms</th>
<th>Mood disturbances</th>
<th>Aches and pains</th>
<th>All symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>SE</td>
<td>p-value</td>
<td>β</td>
<td>SE</td>
</tr>
<tr>
<td>Fingernail cortisol</td>
<td>0.30  (1.89)</td>
<td>0.02</td>
<td>0.02</td>
<td>0.30  (1.97)</td>
<td>0.02</td>
</tr>
<tr>
<td>Perceived stress</td>
<td>0.25  (0.12)</td>
<td>0.06</td>
<td>0.67</td>
<td>0.26  (0.13)</td>
<td>0.05</td>
</tr>
<tr>
<td>Premenopause</td>
<td>-0.18 (0.92)</td>
<td>0.20</td>
<td>0.73</td>
<td>-0.08 (0.96)</td>
<td>0.56</td>
</tr>
<tr>
<td>Perimenopause</td>
<td>0.05  (1.25)</td>
<td>0.73</td>
<td>0.77</td>
<td>0.02  (1.30)</td>
<td>0.87</td>
</tr>
<tr>
<td>BMI</td>
<td>0.04  (0.09)</td>
<td>0.77</td>
<td>0.98</td>
<td>-0.03 (0.09)</td>
<td>0.82</td>
</tr>
<tr>
<td>Tobacco</td>
<td>0.05  (0.93)</td>
<td>0.67</td>
<td>0.68</td>
<td>-0.05 (0.97)</td>
<td>0.68</td>
</tr>
<tr>
<td>SES</td>
<td>-0.25 (0.06)</td>
<td>0.05</td>
<td>0.16</td>
<td>-0.18 (0.06)</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Observations       | 63        | 63        | 63          | 63        | 63          | 63          |
R-squared          | 0.24      | 0.15      | 0.09        | 0.30      | 0.25        | 0.25        |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05
Table 5.7: Multiple linear regression model with high family support

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Emotional instability</th>
<th>Vaso-somatic symptoms</th>
<th>Mood disturbances</th>
<th>Aches and pains</th>
<th>All symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>SE</td>
<td>p-value</td>
<td>β</td>
<td>SE</td>
</tr>
<tr>
<td>Fingernail cortisol</td>
<td>0.24 (1.87)</td>
<td>0.08</td>
<td>0.60</td>
<td>0.07 (0.94)</td>
<td>0.66</td>
</tr>
<tr>
<td>Perceived stress</td>
<td>0.11 (0.11)</td>
<td>0.45</td>
<td>0.19</td>
<td>0.29 (0.06)</td>
<td>0.06</td>
</tr>
<tr>
<td>Premenopause</td>
<td>-0.17 (0.78)</td>
<td>0.23</td>
<td>0.89</td>
<td>-0.12 (0.39)</td>
<td>0.44</td>
</tr>
<tr>
<td>Perimenopause</td>
<td>0.14 (1.24)</td>
<td>0.31</td>
<td>0.22</td>
<td>-0.04 (0.62)</td>
<td>0.81</td>
</tr>
<tr>
<td>BMI</td>
<td>0.10 (0.07)</td>
<td>0.46</td>
<td>0.33</td>
<td>0.19 (0.04)</td>
<td>0.21</td>
</tr>
<tr>
<td>tobacco</td>
<td>-0.15 (0.80)</td>
<td>0.27</td>
<td>0.93</td>
<td>-0.16 (0.40)</td>
<td>0.28</td>
</tr>
<tr>
<td>SES</td>
<td><strong>-0.44 (0.05)</strong>*</td>
<td><strong>0.00</strong></td>
<td><strong>-0.36 (0.06)</strong>*</td>
<td><strong>0.01</strong></td>
<td>-0.16 (0.02)</td>
</tr>
<tr>
<td>Observations</td>
<td>57</td>
<td>57</td>
<td>57</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.32</td>
<td>0.18</td>
<td>0.15</td>
<td>0.17</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05
Table 5.8: Multiple linear regression model with low family support

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Emotional instability</th>
<th>Vaso-somatic symptoms</th>
<th>Mood disturbances</th>
<th>Aches and pains</th>
<th>All symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>SE</td>
<td>p-value</td>
<td>β</td>
<td>SE</td>
</tr>
<tr>
<td>Fingernail cortisol</td>
<td>0.24 (1.92)</td>
<td>0.06</td>
<td>0.11</td>
<td>-0.08 (0.87)</td>
<td>0.53</td>
</tr>
<tr>
<td>Perceived stress</td>
<td><strong>0.26 (0.14)</strong></td>
<td><strong>0.05</strong></td>
<td>0.14</td>
<td>0.07 (0.07)</td>
<td>0.60</td>
</tr>
<tr>
<td>Premenopause</td>
<td>-0.16 (1.08)</td>
<td>0.29</td>
<td>0.47</td>
<td>0.25 (0.49)</td>
<td>0.12</td>
</tr>
<tr>
<td>Perimenopause</td>
<td>0.01 (1.32)</td>
<td>0.92</td>
<td>0.94</td>
<td>0.17 (0.60)</td>
<td>0.26</td>
</tr>
<tr>
<td>BMI</td>
<td>-0.09 (0.13)</td>
<td>0.47</td>
<td>-0.32 (0.12)</td>
<td><strong>0.01</strong></td>
<td>-0.12 (0.06)</td>
</tr>
<tr>
<td>Tobacco</td>
<td>-0.04 (1.07)</td>
<td>0.77</td>
<td>0.68</td>
<td>-0.26 (0.48)</td>
<td>0.06</td>
</tr>
<tr>
<td>SES</td>
<td>-0.01 (0.06)</td>
<td>0.92</td>
<td>0.48</td>
<td>-0.05 (0.03)</td>
<td>0.70</td>
</tr>
<tr>
<td>Observations</td>
<td>62</td>
<td>62</td>
<td>62</td>
<td>62</td>
<td>62</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.17</td>
<td>0.12</td>
<td>0.09</td>
<td>0.20</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05
Table 5.9: Multiple linear regression model with high support from friends

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Emotional instability</th>
<th>Vaso-somatic symptoms</th>
<th>Mood disturbances</th>
<th>Aches and pains</th>
<th>All symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>SE</td>
<td>p-value</td>
<td>β</td>
<td>SE</td>
</tr>
<tr>
<td>Fingernail cortisol</td>
<td>0.14</td>
<td>(1.96)</td>
<td>0.31</td>
<td>0.22</td>
<td>(2.10)</td>
</tr>
<tr>
<td>Perceived stress</td>
<td>0.21</td>
<td>(0.14)</td>
<td>0.21</td>
<td>0.20</td>
<td>(0.16)</td>
</tr>
<tr>
<td>Premenopause</td>
<td>-0.03</td>
<td>(0.97)</td>
<td>0.83</td>
<td>0.09</td>
<td>(1.04)</td>
</tr>
<tr>
<td>Perimenopause</td>
<td>0.11</td>
<td>(1.32)</td>
<td>0.44</td>
<td>0.27</td>
<td>(1.42)</td>
</tr>
<tr>
<td>BMI</td>
<td>0.01</td>
<td>(0.11)</td>
<td>0.95</td>
<td>0.04</td>
<td>(0.12)</td>
</tr>
<tr>
<td>tobacco</td>
<td>-0.17</td>
<td>(1.08)</td>
<td>0.24</td>
<td>0.03</td>
<td>(1.17)</td>
</tr>
<tr>
<td>SES</td>
<td>-0.25</td>
<td>(0.06)</td>
<td>0.06</td>
<td>-0.11</td>
<td>(0.06)</td>
</tr>
</tbody>
</table>

Observations  | 55         | 55       | 55      | 55       | 55       | 55       |
R-squared     | 0.19       | 0.10     | 0.23    | 0.13     | 0.13     | 0.13     |

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05
Table 5.10: Multiple linear regression model with low support from friends

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Emotional instability</th>
<th>Vaso-somatic symptoms</th>
<th>Mood disturbances</th>
<th>Aches and pains</th>
<th>All symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>SE</td>
<td>p-value</td>
<td>β</td>
<td>SE</td>
</tr>
<tr>
<td>Fingernail cortisol</td>
<td>0.24</td>
<td>(1.92)</td>
<td>0.06</td>
<td>0.20</td>
<td>(1.70)</td>
</tr>
<tr>
<td>Perceived stress</td>
<td>0.26 (0.14)</td>
<td>0.05</td>
<td>0.20 (0.13)</td>
<td>0.14</td>
<td>0.07 (0.07)</td>
</tr>
<tr>
<td>Premenopause</td>
<td>-0.16 (1.08)</td>
<td>0.29</td>
<td>-0.11 (0.96)</td>
<td>0.47</td>
<td>0.25 (0.49)</td>
</tr>
<tr>
<td>Perimenopause</td>
<td>0.01 (1.32)</td>
<td>0.92</td>
<td>0.01 (1.17)</td>
<td>0.94</td>
<td>0.17 (0.60)</td>
</tr>
<tr>
<td>BMI</td>
<td>-0.09 (0.13)</td>
<td>0.47</td>
<td>-0.32 (0.12)</td>
<td>0.01</td>
<td>-0.12 (0.06)</td>
</tr>
<tr>
<td>tobacco</td>
<td>-0.04 (1.07)</td>
<td>0.77</td>
<td>-0.05 (0.94)</td>
<td>0.68</td>
<td>-0.26 (0.48)</td>
</tr>
<tr>
<td>SES</td>
<td>-0.01 (0.06)</td>
<td>0.92</td>
<td>0.09 (0.06)</td>
<td>0.48</td>
<td>-0.05 (0.03)</td>
</tr>
<tr>
<td>Observations</td>
<td>62</td>
<td>62</td>
<td>62</td>
<td>62</td>
<td>62</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.17</td>
<td>0.12</td>
<td>0.09</td>
<td>0.20</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05
Discussion

Social support is often conceptualized as an intermediary measure between stressors and health outcomes (Albrecht & Goldsmith, 2003; Cohen et al. 2000; Kaplan et al. 1977). However, few studies have measured the buffering effects of social support on menopausal symptoms (Arnot et al. 2021). In the present study, chronic stress measured by fingernail cortisol and support from family was observed to be associated with emotional instability and total symptoms at midlife after controlling for menopause status, socioeconomic status, BMI, and tobacco use. However, social support (spouse, family, and friends) did not moderate the relationship between chronic stress and symptoms at midlife. The results indicated that fingernail cortisol and support from family were independently associated with total symptoms and subclusters of symptoms such as emotional instability and vaso-somatic symptoms.

It has been well established that stress is associated with more severe menopausal symptoms (Bauld & Brown, 2009; Kling et al. 2019; Nosek et al. 2010; Sood et al. 2019). Studies have shown that an increase in cortisol levels was associated with more severe or frequent hot flashes (Gibson et al. 2016; Woods et al. 2006). Findings from my study also indicated similar results as higher chronic stress, measured by fingernail cortisol level, was observed to be associated with worse overall symptoms at midlife as well as symptoms associated with emotional instability and vaso-somatic symptoms. A recent study on the association between menopause symptoms and the cortisol response assessed by 24-hr urine free cortisol levels (24h UFC) showed a significant association between 24h UFC levels and Greene Climacteric scores at baseline. In addition, the subscores of depression, anxiety, and somatization were independently associated with
24h UFC, but vasomotor symptoms and sexual function were not (Cagnacci et al. 2022).

This is in line with my findings.

My first hypothesis that women who have higher social support will have less severe symptoms at midlife was supported. In particular, higher support from family was associated with less severe symptoms at midlife, as well as symptoms associated with emotional instability. However, neither spousal support nor support from friends showed these relationships. The findings presented here are in concordance with studies indicating that family support decreases the likelihood of symptoms at midlife. For instance, a cross-cultural study from China among Han Chinese and Mosuo women found that perceived support from family ($\beta = -0.210, p = 0.017$), the number of family members ($\beta = -0.229, p = 0.003$), and family income ($\beta = -0.173, p = 0.028$) predicted symptom severity. The authors further suggested that strong social support can help women cope with experiences of loss or grief during the menopausal transition (Zhang et al. 2016). Another study among 732 perimenopausal women in China showed that perceived family support ($\beta = 0.169$ to $0.240, p < 0.001$) was negatively associated with menopausal symptoms (Zhao et al. 2019).

The second hypothesis that social support moderates or buffers the relationship between symptom severity and stress was partially supported. The study found that although family support decreases the likelihood of symptoms at midlife, it did not moderate the relationship between stress and symptom severity. In other words, family support did not act as a moderating variable or a buffer to affect the relationship between stress and symptom outcome. However, support from spouse moderated the relationship between perceived stress and vaso-somatic symptoms. The study indicated that there are
notable differences in the association between perceived stress and vaso-somatic symptoms based on the level of spousal support. More specifically, among Naga women with high spousal support, the magnitude of the association between perceived stress and vaso-somatic symptoms is substantially lower compared to women with lower spousal support. Thus, this finding aligns with the hypothesis that higher levels of support may attenuate the impact of stress on vaso-somatic symptoms, which is in conjunction with other studies (Gold et al. 2006; Jalambadani et al. 2020), where a buffering effect between stress and symptom severity were observed.

These findings are of interest for several reasons. This is the first study to use fingernail cortisol to assess chronic stress in association with symptoms at midlife in India. Multiple studies of cortisol with menopausal symptoms have yielded conflicting results, and this study adds to that existing literature. More importantly, this study adds to the very few studies of chronic stress and symptoms at midlife. In addition, the ease of fingernail cortisol collection, storage, and transportation compared to saliva, urine, or blood makes this method of assessing chronic stress ideal for studies in populations that are otherwise limited by various cultural beliefs. Moreover, this study can be generalized to tribal populations with similar cultural backgrounds in the Indian subcontinent.

Although a causal relationship between social support, stress, and menopausal symptoms cannot be established due to the cross-sectional nature of the study, future studies focusing on this topic could include additional data and approaches to data collection. For instance, collecting longitudinal data would be helpful to establish such relationships. In addition, including more stress biomarkers (e.g., C-reactive protein) could be informative about recent stress in order to make inferences about whether, in the
context of Nagaland, symptoms at midlife are influenced more by recent stress or chronic stress. Furthermore, the supplementary tables indicate a buffering effect between perceived stress and vaso-somatic symptoms through spousal support and are worthy of consideration for future evaluation.

Conclusions

In conclusion, this study shows that women with higher fingernail cortisol levels experience greater emotional instability and more severe overall symptoms at midlife. Those with higher family support experience lower emotional instability and overall symptoms at midlife. In this study, a buffering effect between support from spouse, perceived stress, and vaso-somatic symptoms was observed, supporting the hypothesis that higher levels of support may attenuate the impact of stress on vaso-somatic symptoms among women in Nagaland. These results also highlight the importance of family ties and support for navigating stressors of everyday life among women in Nagaland, more so as the risk of depressive symptoms and other health outcomes are heightened during the menopausal transition (Freeman, 2010; Soares & Frey, 2010).
APPENDIX:
QUESTIONNAIRES

Greene climacteric scale (Greene, 1976)

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Not at all</th>
<th>A little</th>
<th>Quite a bit</th>
<th>Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart beating quickly or strongly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeling tense or nervous</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty in sleeping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excitable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attacks of anxiety, panic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty in concentrating</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeling tired or lack in energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of interest in most things</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeling unhappy or depressed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crying spells</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irritability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeling dizzy or faint</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure or tightness in head</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parts of body feel numb</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Headaches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muscle and joint pains</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of feeling in hands or feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breathing difficulties</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hot flushes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweating at night</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of interest in sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Perceived Stress Scale-10 (Cohen et al. 1994)

For each question choose from the following alternatives:
0 - never 1 - almost never 2 - sometimes 3 - fairly often 4 - very often

1. In the last month, how often have you been upset because of something that happened unexpectedly?
2. In the last month, how often have you felt that you were unable to control the important things in your life?
3. In the last month, how often have you felt nervous and stressed?
4. In the last month, how often have you felt confident about your ability to handle your personal problems?
5. In the last month, how often have you felt that things were going your way?
6. In the last month, how often have you found that you could not cope with all the things that you had to do?
7. In the last month, how often have you been able to control irritations in your life?
8. In the last month, how often have you felt that you were on top of things?
9. In the last month, how often have you been angered because of things that happened that were outside of your control?

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

**Multidimensional Scale of Perceived Social Support** (Zimet et al. 1988)

Instructions: We are interested in how you feel about the following statements. Read each statement carefully. Indicate how you feel about each statement.

Circle the “1” if you Very Strongly Disagree  
Circle the “2” if you Strongly Disagree  
Circle the “3” if you Mildly Disagree  
Circle the “4” if you are Neutral  
Circle the “5” if you Mildly Agree  
Circle the “6” if you Strongly Agree  
Circle the “7” if you Very Strongly Agree

1. There is a special person who is around when I am in need.  
2. There is a special person with whom I can share my joys and sorrows.  
3. My family really tries to help me  
4. I get the emotional help and support I need from my family.  
5. I have a special person who is a real source of comfort to me  
6. My friends really try to help me  
7. I can count on my friends when things go wrong  
8. I can talk about my problems with my family  
9. I have friends with whom I can share my joys and sorrows.  
10. There is a special person in my life who cares about my feelings  
11. My family is willing to help me make decisions  
12. I can talk about my problems with my friends.

The items tended to be divided into factor groups relating to the source of the social support, namely family (Fam), friends (Fri) or significant other (SO).
**Beck's Depression Inventory** (Beck et al. 1996)

1. 0. I do not feel sad.
   1. I feel sad.
   2. I am sad all the time and I can't snap out of it.
   3. I am so sad and unhappy that I can't stand it.

2. 0. I am not particularly discouraged about the future.
   1. I feel discouraged about the future.
   2. I feel I have nothing to look forward to.
   3. I feel the future is hopeless and that things cannot improve.

3. 0. I do not feel like a failure.
   1. I feel I have failed more than the average person.
   2. As I look back on my life, all I can see is a lot of failures.
   3. I feel I am a complete failure as a person.

4. 0. I get as much satisfaction out of things as I used to.
   1. I don't enjoy things the way I used to.
   2. I don't get real satisfaction out of anything anymore.
   3. I am dissatisfied or bored with everything.

5. 0. I don't feel particularly guilty.
   1. I feel guilty a good part of the time.
   2. I feel quite guilty most of the time.
   3. I feel guilty all of the time.

6. 0. I don't feel I am being punished.
   1. I feel I may be punished.
   2. I expect to be punished.
   3. I feel I am being punished.

7. 0. I don't feel disappointed in myself.
   1. I am disappointed in myself.
   2. I am disgusted with myself.
   3. I hate myself.

8. 0. I don't feel I am any worse than anybody else.
   1. I am critical of myself for my weaknesses or mistakes.
   2. I blame myself all the time for my faults.
   3. I blame myself for everything bad that happens.

9. 0. I don't have any thoughts of killing myself.
1. I have thoughts of killing myself, but I would not carry them out.
2. I would like to kill myself.
3. I would kill myself if I had the chance.

10. 
0. I don't cry any more than usual.
1. I cry more now than I used to.
2. I cry all the time now.
3. I used to be able to cry, but now I can't cry even though I want to.

11. 
0. I am no more irritated by things than I ever was.
1. I am slightly more irritated now than usual.
2. I am quite annoyed or irritated a good deal of the time.
3. I feel irritated all the time.

12. 
0. I have not lost interest in other people.
1. I am less interested in other people than I used to be.
2. I have lost most of my interest in other people.
3. I have lost all of my interest in other people.

13. 
0. I make decisions about as well as I ever could.
1. I put off making decisions more than I used to.
2. I have greater difficulty in making decisions more than I used to.
3. I can't make decisions at all anymore.

14. 
0. I don't feel that I look any worse than I used to.
1. I am worried that I am looking old or unattractive.
2. I feel there are permanent changes in my appearance that make me look unattractive.
3. I believe that I look ugly.

15. 
0. I can work about as well as before.
1. It takes an extra effort to get started at doing something.
2. I have to push myself very hard to do anything.
3. I can't do any work at all.

16. 
0. I can sleep as well as usual.
1. I don't sleep as well as I used to.
2. I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
3. I wake up several hours earlier than I used to and cannot get back to sleep.

17. 
0. I don't get more tired than usual.
1. I get tired more easily than I used to.
2. I get tired from doing almost anything.
3. I am too tired to do anything.

18. My appetite is no worse than usual.
   1. My appetite is not as good as it used to be.
   2. My appetite is much worse now.
   3. I have no appetite at all anymore.

19. I haven't lost much weight, if any, lately.
   1. I have lost more than five pounds.
   2. I have lost more than ten pounds.
   3. I have lost more than fifteen pounds.

20. I am no more worried about my health than usual.
   1. I am worried about physical problems like aches, pains, upset stomach, or constipation.
   2. I am very worried about physical problems and it's hard to think of much else.
   3. I am so worried about my physical problems that I cannot think of anything else.

21. I have not noticed any recent change in my interest in sex.
   1. I am less interested in sex than I used to be.
   2. I have almost no interest in sex.
   3. I have lost interest in sex completely.

**Socio-economic status scale (Adapted from Aggarwal et al. 2005)**

1. Monthly per capita income from all sources (total monthly income /no. of family members)
   1. >50000
   2. 20000-49999
   3. 10000-19999
   4. 5000-9999
   5. 2500-4999
   6. 1000-2499
   7. <1000

2. Education of either husband or wife who is more educated among them.
   1. Professional qualification with technical degree or diplomas e.g., Dr, Eng. CA, MBA etc.
   2. Postgraduation non-technical (including PhD)
   3. Graduation
   4. 10 class pass but <graduation
   5. Primary pass but <10th
   6. <Primary but attended school for at least 1 year
   7. Just literate but no Schooling
   8. Illiterate

3. Occupation of husband, otherwise wife

126
1. Service in central/state/public undertakings or owner of a company employing
   >20 or self-employed professional viz Doctors, CAs, Eng. Etc. 5
2. Service in Private sector or independent business employing 2-20 persons 4
3. Service at shop, home, transport, own cultivation of land 3
4. Self-employed e.g. shops, Rehdies or petty business with income >5000 2
5. Self-employed with income <5000 (laborer, housewife) 1
6. None of the family members is employed 0
4. Family possessions (presence of each item given below will carry a score of ‘1’)
5. Living in a type of house
   1. Own house with 5 or more rooms 7
   2. Own house with 3-4 rooms 6
   3. Rented/Govt. house with 5 or more rooms 6
   4. Own house with 1-2 rooms 5
   5. Rented/Govt. house with 3-4 rooms 5
   6. Rented/Govt. house with 1-2 rooms 4
   7. Own jhuggi 3
   8. Rented jhuggi 2
   9. No place to live, pavement, mobile cart 1
6. Possession of a vehicle or equivalent
   1. 2 or more cars/Tractors/Trucks 4
   2. 1 car/tractor/truck 3
   3. 1 or more scooter (s)/ Bullock cart (s) 2
   4. 1 or more cycles (not baby cycle) 1
   5. None of the above 0
7. No. of earning members in the family (Nuclear/Joint)
   1. 3 or more members earning and income pooled 3
   2. 2 or both husband and wife earning 2
   3. Only 1 family member earning 1
   4. No earning member 0
8. No. of children head of the family has/had
   1. 0-1 5
   2. 2 4
   3. 3 3
   4. 4 2
   5. 5 1
   6. >6 0
9. Facility of some essentials in the family
   1. Both tap water supply and electricity 2
   2. Only one of above two is present 1
   3. None is present 0
10. Education of children (in relation to head of the family)
    Note: Exclude under 5 children for this item. A child applicable here is one who is 5 yrs
    or above.
    1. All children going/ever gone to school/college 3
2. >50% children ever gone/going to school/college 2
3. < 50% children ever gone/going to school/college 1
4. No child ever gone/going to school/college 0

11. Employment of a domestic servant at home
   1. Employed >2 full time servants on salary for domestic work 4
   2. Employed only 1 full time servant on salary for domestic work 3
   3. Employed > 3 part time servants on salary for domestic work 2
   4. Employed 1-2 part time servants on salary for domestic work 1
   5. Employed no servants for domestic work 0

12. Type of locality the family is residing
   1. Living in urban locality 5
   2. Living in rural locality 4
   3. Living in resettlement colony 3
   4. Living in slums/jhuggis 2
   5. No fixed living and mobile 1

13. Positions held (besides the positions as employee) by any one member in the family
   1. Holding position of 3 or more official or non-official organizations viz. president/chairman/secretary/treasurer etc. 4
   2. Holding positions of 1-2 official or non-official organizations viz. president/chairman/secretary/treasurer etc. 3
   3. Holding positions as member-only of executive or other committees of official or non-official organizations 2
   4. Does not hold any such positions 1

**Open-ended questions:**

**Insurgency problems**
Do you consider Nagaland to be a peaceful state? Why? Why not?
Do you think the current factions in Nagaland are fighting for the greater good of the state?
Do you think their motifs have changed since their inception? Why? Why not?
To what extent were you or your family members affected by the problems of insurgency?
Did you or your family ever witness shootings within the state of Nagaland?
Are the taxes levied by the factions a burden to your family?
Were any of your personal belongings destroyed by force by the factions?
Were you or any of your family members injured due to violence caused by the factions?
Were you or your family forced to give money to the factions?
Have you ever feared going out at night because of the killings by the faction?
Were you or your family ever feared carrying out daily activities?

**Political conflict**
Are you satisfied with the current government of India?
Do you think the government of India provides ample support to the state of Nagaland?
Why? Why not?
Do you think the govt. of India provides adequate support and equal opportunity for people from the minority group? Why? Why not?
Do you participate actively in political activities?
Are you satisfied with the work of the current govt. of Nagaland in terms of medical sector, infrastructure, transport, etc.? Why? Why not?
Were you or your family members injured due to the violence caused by the political conflicts in Nagaland (election, CAA, 30% quota, etc.)?
To what extent were you or your family members affected by the ban triggered by the protest (CAA, 30% reservation, etc.)?
BIBLIOGRAPHY


https://doi.org/10.1016/j.socscimed.2009.09.035


https://doi.org/10.1067/mjd.2001.117432


https://doi.org/10.1097/00042192-200007030-00009

146


