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Empowering Caregivers by Enhancing Resilience and Reducing Stress in Breast Cancer Care at Shri Shankara Cancer Hospital Bangalore

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Abstract:
Cancer encompasses a wide range of disorders that may develop in almost any tissue or organ within the human body. This occurs when abnormal cells proliferate unchecked, surpassing normal boundaries to infiltrate other areas of the body or disseminate to multiple organs. Cancer has a profound effect on both the sufferer and the caregiver. Breast cancer sufferers present several obstacles to their caregivers, who are essential in providing physical, emotional, and psychological support along the way. This study utilized an empirical case study methodology to gain a comprehensive understanding of the experiences, challenges, and coping strategies of caregivers for patients undergoing therapy at the Shri Shankara Cancer Hospital and Research Centre in Bangalore, India. The research examines the effectiveness of focused treatments meant to reduce stress and build endurance in the primary caregivers of certain cancer survivors. Recognizing the critical role caregivers play in assisting cancer survivors, this study employs a combination of methods that incorporates both quantitative evaluations and qualitative interviews. The effects of certain treatments, such as mindfulness-based methods, peer support groups, and psychological education, on resilience variables and caregiver levels of stress are tested through implementation and evaluation. The results indicate that after participating in the treatments, caregivers' happiness significantly improved, with lower levels of stress and increased adaptability. These findings underscore the significance of caregiver-specific support programs in resource-limited settings such as Bangalore, offering insights to inform future initiatives and enhance the quality of care for cancer survivors and their families.

Keywords: Primary Caregivers; Cancer Survivors; Stress and Resilience; Psychoeducation; Resource-Constrained Settings; Caregiver Support; Quality of Care; Family Support

1 Introduction

Receiving a cancer diagnosis is a historic event that has a tremendous impact on everyone it affects. While it's common for medical professionals and the general public to focus on those who have tumors, it's crucial to remember that caregivers also provide constant encouragement, understanding, and attention [1]. With a focus on the complex psychological elements underlying their experiences, this study ventures into the unexplored field of caregiver mental health within the broader context of the cancer journey. Providing care for a loved one with cancer is a psychologically complex and emotionally demanding responsibility [2]. The unique stress associated with this role arises from the intimate observation of a loved one's battle with cancer. Caregivers often grapple with a multitude of complex emotions, including worry, despair, and a profound sense of helplessness, stemming from these psychological pressures, which can be profoundly challenging. Moreover, feelings of guilt often compound these emotional strains, as caregivers may erroneously believe they are not providing adequate support or are unable to alleviate their loved one's suffering [3].

From a psychological standpoint, providing care often leads to what psychologists term "caregiver burden". This encompasses the array of psychological, social, and emotional strains experienced by individuals caring for their loved

ones. Anxiety and sadness commonly arise as psychological manifestations of this burden. Disruptions to daily routines can result in social stress, while emotional strain is often compounded by the constant anxiety and vigilance inherent in the caregiving role [4].

The psychological effects of caregiving for a cancer patient can be particularly pronounced due to the severity of the illness and the prolonged duration of treatment. This research aims to shed light on the emotional challenges confronted by cancer caregivers and provide insights into the psychological intricacies of their journey. It's crucial to acknowledge that cancer exacts a psychological toll on caregivers as well, encompassing feelings of anxiety, sadness, and a profound sense of helplessness [5]. From a psychological perspective, the dynamic between the patient's prognosis and the caregiver's mental well-being is intricate and multifaceted. Elevated levels of stress and despair among caregivers have the potential to adversely impact their overall health. The intricate interplay between caregiver and patient well-being underscores the importance of addressing caregiver mental health from a psychological standpoint [6].

The main objectives of this study are to underscore the psychological importance of caregiver well-being and to offer insights into practical psychological support and treatment techniques. This research seeks to enhance our understanding of caregiver well-being from a psychological perspective and contribute to a more comprehensive understanding of holistic cancer treatment [7]. It aims to deepen our understanding of the mental processes involved for both loved ones and support groups and psychology professionals and medical practitioners. The ultimate aim is to enhance the overall quality of life for both cancer patients and caregivers and to advocate for a more comprehensive and compassionate approach to the disease. This approach recognizes and addresses the unique psychological challenges faced by dedicated caregivers [8].

Cancer in childhood profoundly impacts both the child and their caregivers, leaving lasting effects on their psychological well-being. In India, the number of child cancer survivors has surpassed 500,000 due to improving survival rates over time. However, cancer remains the leading cause of death in the first twenty years of life, second only to trauma. Aggressive treatments like craniospinal irradiation, hematopoietic stem cell transplantation, and sub myeloablative chemotherapy have been pivotal in curing childhood cancer, despite posing short-term risks for long-term benefits [9]. Children with cancer often experience severe bacterial infections, prolonged hospitalizations, intensive medical interventions such as mechanical ventilation, and widespread mucositis. Despite advances in cancer therapies increasing the number of Childhood Cancer Survivors (CCSs), survivors frequently contend with physical, psychological, and social challenges post-treatment [10].

Throughout the cancer journey, families play a crucial role in providing their children with healthcare, emotional support, and financial assistance. However, caregiving can be emotionally taxing, with many CCS caregivers reporting feelings of distress, despair, and stress [11]. These caregivers are often required to balance caregiving responsibilities with their daily routines without prior experience or external support. Caregivers provide personal, overall, and household support, which can lead to feelings of extreme strain and stress. Previous studies have linked high levels of caregiver burden to emotional distress, with potentially detrimental effects on their physical and mental well-being [12].

1.1 Problem Statement

In 2023, breast cancer resulted in the deaths of 685,000 individuals globally, with 2.3 million new diagnoses reported. It continues to be one of the most prevalent cancers worldwide, with 7.8 million women alive at the end of 2023 having received a diagnosis within the previous five years. Breast cancer imposes a greater burden of Disability-Adjusted Life Years (DALYs) on women globally than any other malignancy. Although breast cancer can occur in women at any age post-adolescence, its incidence typically rises with age. The breast cancer scenario presents a significant challenge both internationally and in India. Since 2018, there has been a 20% increase in breast cancer incidence in India, with 1.7 million new cases detected in women in 2023 alone. 6.3 million Women were living with the disease in the five years leading up to 2023. Breast cancer ranks among the leading causes of cancer-related deaths in women, with 521,817 deaths reported in 2023. It is the most frequently diagnosed cancer among women in 140 out of 184 countries worldwide, representing one in every four female cancer cases.

For the first time in Karnataka state, breast cancer has surpassed cervical cancer as the most common cancer among women and the leading cause of cancer-related deaths. Cervical cancer, traditionally more prevalent in rural areas where approximately 80–85% of Indian women reside, has seen a decrease in incidence compared to breast cancer. In India's cities and rural areas, cancer ranks as the second and fourth most common cause of mortality among adults, correspondingly. In Karnataka state, there has been an increase in the number of close family members taking on the role of caregiver, paralleling the rising trend of breast cancer diagnoses. Long-term caregiving is known to significantly impact a person's mental, emotional, and financial well-being, leading caregivers to adopt various coping mechanisms.

1.2 Motivation

This research was inspired by the recognition of the critical role primary caregivers play in providing support and

encouragement to cancer survivors. While caregivers make invaluable contributions, often bear a heavy emotional and psychological burden that can adversely affect their health and their ability to provide quality care. These challenges are exacerbated in resource-limited settings such as Bangalore, where support networks may be sparse. The current study aims to alleviate caregiver stress and enhance the quality of care provided to cancer survivors and their families by evaluating the effectiveness of specific interventions designed to manage caregiver stress and build resilience. The long-term goal is to improve caregivers' access to support networks, leading to better outcomes for both caregivers and survivors within Bangalore's cancer treatment systems.

2 Related Works

To handle and overcome the psychosocial challenges of caregiving, caregivers of Childhood Cancer survivors (CCSs) must engage in a dynamic process of psychological adaptation that includes coping mechanisms and social behaviors. A framework is provided to understand the coping mechanisms caregivers use in response to the stresses associated with caregiving [13]. These stresses may stem from the emotional trauma of watching a loved one undergo cancer treatment, the fear of cancer recurrence, or the difficulties involved in providing personal care. A person's ability to face and overcome these obstacles is influenced by their adaptability and external support, such as essential, emotional, familial, or informational assistance [14].

Due to their cultural heritage, Hispanic caregivers of CCSs may face unique challenges that influence how they manage the rigors of caregiving. Furthermore, it's essential to consider age- and culture-specific conventions and beliefs that could affect how someone adapts to caregiving. Studies have shown that Hispanic caregivers face significant social isolation and limited access to culturally sensitive assistance programs, both of which can negatively impact their mental well-being and overall health [15]. Hispanic caregivers of children with cancer are not well-represented in the literature. Understanding the perspectives of Hispanic caregivers of CCSs is crucial to creating effective interventions that reduce caregiver stress and enhance psychological well-being in this particular demographic. The purpose of the qualitative research was to gather detailed data about the specific difficulties and challenges faced by Hispanic caregivers of CCSs and how these affect their mental well-being and coping mechanisms [16]. Cancer care is a vast field that encompasses more than just medical procedures and hospital boundaries. It includes a network of caregivers who often go unnoticed but are vital to a patient's journey [17]. These unseen heroes—whether they are relatives, close companions, or paid caregivers—offer crucial emotional, mental, and logistical support to those dealing with cancer. A complex web of caregivers provides a lifeline for individuals facing a frightening diagnosis [18].

They are the pillars of strength, attending to daily necessities, offering companionship during hospitalizations, and administering medications. However, their importance goes beyond these practical duties; they are integral to the patient's cancer experience. Caregivers provide a constant presence during times of fear and uncertainty, holding the patient's mental health in their hands [19]. Cancer takes an emotional toll on caregivers as well; these individuals frequently experience feelings of powerlessness, worry, and sadness while watching their loved ones battle the illness. Caregivers are crucial because they provide consistent emotional support and serve as beacons of hope during difficult times [20]. By acting as advocates, caregivers ensure that patients' concerns are acknowledged, their questions are answered, and their treatment plans are understood, thereby maintaining vital communication within the healthcare system [21].

Caregivers discussed the environmental challenges, the psychological effects of these challenges encountered before and after cancer treatment, and the coping mechanisms they developed in response to these difficulties and traumatic events during the interviews [22]. The conceptual framework employed is visually summarized in Figure 1 illustrating the relationship between stressors and coping strategies [23].

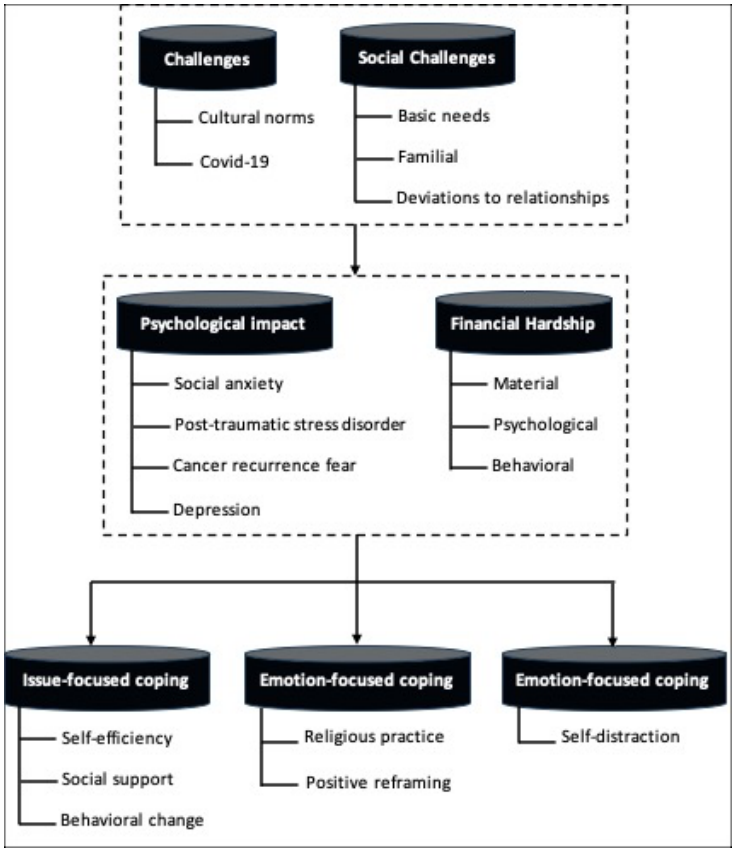

Figure 1. Representation of conceptual structure of caregivers

There is a lack of research on effective approaches to reducing caregiver stress and enhancing resilience, particularly in resource-limited environments like Bangalore, India [24]. Despite growing recognition of the critical role primary caregivers play in the continuum of cancer survivorship care [25]. Existing studies often focus primarily on the needs and challenges faced by cancer survivors, frequently overlooking the psychological and emotional difficulties experienced by caregivers [26].

There is limited data on the suitability and effectiveness of specific interventions in low-resource contexts, even though many have been studied in high-resource settings. By evaluating the impact of targeted interventions—such as psychoeducation, peer support groups, and mindfulness practices—on reducing stress and enhancing resilience among primary caregivers of cancer survivors in Bangalore, this study aims to address the current knowledge gap. The findings are intended to provide valuable insights and inform the development of regionally and culturally appropriate support networks for caregivers in similar settings [27].

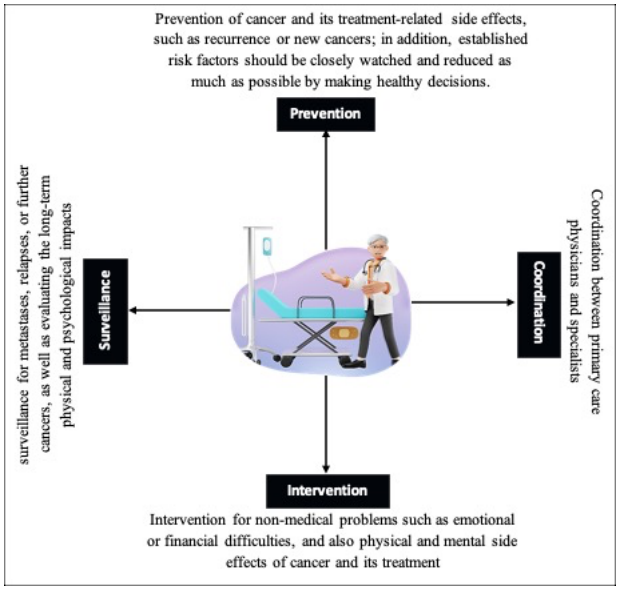

Figure 2: Emotions, preventions, surveillance, and coordination of caretakers

3. Materials and Methods

Unregulated cell proliferation is a defining characteristic of cancer, a group of disorders that disrupt normal bodily functions and pose a significant threat to patients' lives. Cancer is a complex disease that arises from multiple genetic alterations leading to uncontrolled cell growth and the potential for metastasis. Genetic changes, occurring within the Deoxyribo Nucleic Acid (DNA), have been strongly linked to cancer development. Each gene within DNA encodes specific proteins or enzymes.

Protooncogenes, which regulate normal cell growth, and tumor suppressor genes, which produce proteins that control cell development, are two crucial genes essential for regulating cell proliferation. Additionally, the body eliminates excess or damaged cells through a process called programmed cell death, or apoptosis, to maintain balance. Mutations in these genes promote uncontrolled cell division, contributing to cancer progression.

Caregivers act as liaisons between patients and their medical teams, fostering cooperation that leads to more informed decisions. The importance of caregivers in cancer care extends beyond the patient and impacts all aspects of the medical system. Promoting the overall well-being of both patients and caregivers requires recognizing and supporting the caregivers themselves. In the context of One Health, ensuring caregivers have access to the necessary resources, information, and emotional support is not only compassionate but also essential for holistic care shown in Figure 2.

3.1 Dataset

A fictitious database from Bangalore's Shri Shankara Cancer Center and Study Centre on breast, uterine cancer, and cervical is shown in Table 1.

Table 1: Dataset description

Attribute	Description	Type	Example
Patient ID	A unique identifier is assigned to each patient	Integer/String	001
Age	Age of the patient at the time of data collection	Integer	45
Gender	The gender of the patient	String	Female
Cancer Type	Type of cancer diagnosed	String	Breast
Stage at Diagnosis	Cancer stage at the time of diagnosis	String	II
Treatment Type	Type of treatment received	String	Chemotherapy
Treatment Start Date	Date when the treatment commenced	Date	2023-01-10
Outcome	Current status of the patient	String	In Treatment
Follow-Up Status	Whether the patient is still under follow-up care	String	Active
Caregiver Stress Level (Pre-Intervention)	The initial stress level of the primary caregiver before interventions	String	High
Caregiver Resilience Score (Pre-Intervention)	Initial resilience score of the primary caregiver before interventions	String	Low

Table 2 provides a clear and organized summary of the properties of the dataset, making it easy to understand the type and nature of each piece of information that has been collected.

Table 2: Sample datasets and its properties

Patient ID	Age	Gender	Cancer Type	Stage at Diagnosis	Treatment Type	Treatment Start Date	Outcome	Follow-Up Status	Caregiver Stress Level (Pre-Intervention)	Caregiver Resilience Score (Pre-Intervention)
001	45	Female	Breast	II	Chemotherapy	2023-01-10	In Treatment	Active	High	Low
002	52	Female	Cervical	III	Radiation	2023-02-15	Remission	Active	Moderate	Moderate
003	38	Female	Uterine	I	Surgery	2023-03-	In	Active	High	Low

Patient ID	Age	Gender	Cancer Type	Stage at Diagnosis	Treatment Type	Treatment Start Date	Outcome	Follow-Up Status	Caregiver Stress Level (Pre-Intervention)	Caregiver Resilience Score (Pre-Intervention)
						20	Treatment			
004	60	Female	Breast	IV	Palliative Care	2023-01-05	Deceased	Inactive	High	Low
005	47	Female	Cervical	II	Chemotherapy	2023-04-10	In Treatment	Active	Moderate	Moderate
006	55	Female	Uterine	III	Chemotherapy	2023-02-25	In Treatment	Active	High	Low
007	50	Female	Breast	I	Surgery	2023-03-15	Remission	Active	Low	High
008	42	Female	Cervical	II	Radiation	2023-04-05	In Treatment	Active	High	Moderate
009	49	Female	Uterine	IV	Chemotherapy	2023-01-20	In Treatment	Active	High	Low
010	53	Female	Breast	III	Chemotherapy	2023-02-10	In Treatment	Active	Moderate	Moderate

Key Descriptions

- Patient ID: Unique identifier of every patient.
- Age: Patient Age.
- Gender: Patient Gender.
- Cancer Type: Cancer Type (Breast, Cervical, Uterine).
- Stage at Diagnosis: Cancer stage at the diagnosis time.
- Treatment Type: Type of treatment received (Radiation, Chemotherapy, Palliative Care, Surgery).
- Treatment Start Date: Date when the treatment commenced.
- Outcome: Current status of the patient (In Treatment, Deceased, Remission).
- Follow-Up Status: Whether the patient is still under follow-up care (Active, Inactive).
- Caregiver Stress Level (Pre-Intervention): Initial stress level of the primary caregiver before interventions (High, Moderate, Low).
- Caregiver Resilience Score (Pre-Intervention): Initial resilience score of the primary caregiver before interventions (High, Moderate, Low).

To analyze the effects of certain treatments on caregiver stress and resilience, it might be very helpful to get a quick overview of the caregiver illnesses therapy information, and demography that are provided by this set of data.

3.2 Cancer Patients Facing Challenges

A cancer diagnosis can profoundly impact caregivers, relationships, and the mental well-being of those affected. Stress, difficulty, and despair are common emotions experienced throughout this transformative journey. There may be repercussions on employment, school, and home life. With advancements in treatment and increased accessibility, the overall survival rate for people with breast cancer has significantly improved. After undergoing treatments such as radiation, biotherapy, hormone therapy, or reconstructive procedures, women suffering from breast cancer may experience various physical and mental issues, in addition to a reduced quality of life worldwide.

Post-treatment, breast cancer survivors may encounter significant changes in their sexual desire, along with fatigue, nipple hypersensitivity loss, dryness, and scarring. Even after diagnosis and treatment, psychological issues, including melancholy, anxiety, and despair stemming from treatment, recurrence, and physical deformity, persist. Among the major psychological problems are:

1. Fear of recurrence: Many patients worry that their illness will return someday.

2. Grief and misery: Common outcomes of misfortune, such as well-being, sexual desire, productivity, and true independence.
3. Depression: It's estimated that 70% of cancer survivors experience periods of despondency.
4. Self-perception: Lack of confidence can have detrimental impacts on cancer survivors who have undergone surgeries, deformities, or severe changes in their abilities. Poor self-perception can also affect one's desire for intimacy and social interaction.

Survivors of breast cancer may face challenges in social integration due to a lack of communication and support from spouses, families, and friends. Furthermore, they are more susceptible to other health problems, including cardiovascular disease, irregular menstruation, and osteoporosis. Low levels of physical activity and unhealthy eating habits are other prevalent issues linked to breast cancer recurrence.

3.2 Care Givers

A cancer diagnosis can profoundly impact caregivers, relationships, and the mental well-being of those affected. Stress, difficulty, and despair are common emotions experienced throughout this transformative journey. Caregivers, in particular, play a crucial role in providing support and assistance to individuals facing cancer. Experience significant emotional and psychological strain as witness of loved ones battle the illness. Caregivers may face challenges in balancing their caregiving responsibilities with other aspects of their lives, such as employment and personal relationships. Despite the difficulties they encounter, caregivers remain steadfast in their support, offering emotional comfort and practical assistance to those in need. Their dedication and resilience are essential components of the cancer care journey.

3.3 Level of Stress and Coping among Primary Caregivers before and after Interventions

Before receiving treatments, primary caregivers frequently struggle with various stress levels, which can have a significant negative effect on their general well-being. Caregivers experience a variety of stresses, including psychological, physical, and emotional ones. It might be brought on by the demanding nature of caring duties, unknowns regarding the patient's health, monetary difficulties, and interruptions to one's personal and professional life. Standardization measures such as the Perceived Stress Scale (PSS) which measures personal views on stress, are frequently used to determine the degree of stress.

Caregivers use coping techniques to deal with stress; these might include inappropriate tactics like avoiding or denial, in addition to solutions like solving issues and seeking out social support. Caregivers' capacity to manage the difficulties of caregiving might be impacted by how well these coping methods work for them. Before treatments, the effectiveness of caregivers' coping methods and their actual stress levels interact complexly to influence how well-off individuals. Comprehending these processes is essential to developing specific programs meant to improve caregiver resiliency and successfully reduce stressful concentrations. Utilize quantitative measures and algorithms to numerically depict the main caregivers' anxiety and resilience levels before treatments.

3.3.1 Level of Stress (S)

A standardized stress scale can be used to illustrate the degree of stress that the main caregivers face. The Perceived Stress Scale (PSS), which gives numerical values to answers on a questionnaire evaluating the sense of being stressed in various circumstances, is one frequently utilized scale. Researchers are going to refer to the result of the Perceived Stress Scale as PSS.

S = PSS (1)

3.3.2 Coping Mechanisms (C)

Caregiver coping processes may be measured by examining the quantity and efficacy of various approaches to coping. We'll use the notation CM for the Coping Mechanisms score.

$$C = \frac{Effective\ Coping\ Strategies}{Total\ Coping\ Strategies} \quad (2)$$

Where:

Successful Coping Strategies: The quantity of coping mechanisms thought to be useful in stress management for caregivers.

Complete Coping Methods: The caregiver's complete usage of methods of coping.

3.3.3 Overall Well-being (W):

The combination of psychological stress and responding efficiency may be used to indicate the general health of caregivers before treatments.

$W=S\times C$ *(3)*

Where:

W: General psychological ratings

S: Stress level (score on the Perceived Stress Scale).

C: Score for Coping Mechanisms.

Equations (1) – (3) illustrate how lower general happiness ratings are related to higher levels of anxiety and/or less efficient management. Before treatments, it offers a quantitative structure for evaluating the stress and resilience levels of the primary caregivers. It can assess the efficacy of treatments in enhancing caregivers' happiness and gain a better understanding of their initial circumstances by utilizing standardized surveys and coping strategy analysis.

3.4 **Level of Stress and Coping among Primary Caregivers After Interventions**

Primary caregivers often report significant changes in their coping strategies and stress levels after undergoing treatments subsequently improving their overall well-being. Interventions tailored to meet caregiver needs typically focus on providing coping mechanisms, knowledge, and encouragement to navigate the challenges of caregiving. Examples of such approaches include psychoeducational sessions, group therapy, mindfulness-based activities, and access to community support networks.

Participation in these programs enables caregivers to reduce their perceived stress levels by acquiring essential skills and insights into more effective stress management. They may establish a stronger support network and adopt better-coping strategies, such as seeking assistance from others and utilizing problem-solving techniques. Quantitative assessments conducted post-intervention may reveal lower Perceived Stress Scale (PSS) scores, indicating a reduction in caregivers' subjective experiences of stress. Additionally, there may be an increase in Coping Mechanisms scores, indicating greater utilization of practical coping strategies. The overall sense of well-being among caregivers is enhanced by a combination of reduced stress levels and improved coping strategies.

The findings underscore the effectiveness of targeted interventions in supporting caregivers and emphasize the importance of ongoing support in maintaining caregiver resilience in challenging caregiving situations. Standard measures can be utilized to quantify changes in caregivers' stress levels and coping strategies accurately. The Level of Stress after Treatment will be shown by S_{after} and the coping mechanisms after interventions as C_{after}

$S_{after} = PSS_{after}$ (4)

$C_{after} = \frac{Effective\ Coping\ Strategies_{after}}{Total\ Coping\ Strategies\ _{after}}$ (5)

Where:

PSS_{after} Perceived Stress Scale score after interventions

$Effective\ Coping\ Strategies\ _{after}$ The number of effective coping strategies employed after interventions

$Total\ Coping\ Strategies\ _{after}$ The total number of coping strategies employed after interventions

The overall well-being of caregivers after interventions W_{after} can be represented as:

$$W_{after} = S_{after} \times C\ _{after} \quad (6)$$

Equations (4)-(6) offer a quantitative framework for evaluating how treatments affect the stress levels, coping strategies, and general health of caregivers. Scientists can assess how well treatments help carers and strengthen their capacity for adaptation to cope with the obligations of caring by examining modifications to these parameters after the treatment.

3.5 Assessing the effectiveness of interventions on stress and coping among primary caregivers of cancer patient

A thorough methodology that integrates both quantitative and qualitative assessments is necessary to evaluate the impact of treatments on anxiety and the ability to cope among the main caregivers of people with cancer. In quantitative evaluation, caregivers are given questionnaires both before and after the treatment. Standard instruments such as the Coping Mechanisms Inventory and the PSS are used to measure modifications to coping mechanisms and stress levels as time passes. Analyzing the survey results statistically enables the detection of noteworthy changes in caregiver health that can be linked to the treatment. Qualitative techniques, including semi-structured interviews, complement the quantitative information by providing a better understanding of caregivers' knowledge, perspectives, and the complex effects of treatments on their coping strategies and stress levels.

Topics about the success of the treatment, the difficulties that caregivers experience, and the tactics they use come to light through qualitative investigation, giving quantitative results major context. A thorough knowledge of the effects of treatments on stress and coping among the main caregivers of people with cancer may be attained by combining quantitative and qualitative data. This knowledge will direct the creation of focused assistance initiatives to improve caregiver health. Quantitative measurements are used in conjunction with statistical analysis to determine significant modifications in the stress and coping levels of primary caregivers of people with cancer to evaluate the efficiency of therapies.

S_{before}: Level of stress before interventions

S_{after}: Level of stress after interventions

C_{before}: Coping mechanisms before interventions

C_{after}: Coping mechanisms after interventions

To quantify the changes in stress levels and coping mechanisms, the following equations can be utilized:

$\Delta S = S_{after} - S_{before}$ (7)

$\Delta C = C_{after} - C_{before}$ (8)

Where:

ΔS change in stress levels.

ΔC change in coping mechanisms

Utilize statistical tests such as paired t-tests to ascertain the importance of variations in stress levels and coping strategies before and after interventions. To determine if the variations seen are statistically significant, these tests compare the means of each variable before and after interventions.

$t = \frac{\hat{I}_{after} - \hat{I}_{before}}{s/\sqrt{n}}$ (9)

Where:

t t-value from the paired t-test.

$\hat{I}_{after}$ Mean of stress or coping scores after interventions

$\hat{I}_{before}$ Mean of stress or coping scores before interventions

s: Standard deviation of the difference between after and before scores.

n: No. of caregivers.

Equations (7) – (9) statistical tests allow researchers to assess treatments' effects on stress and coping mechanisms among the primary caregivers of cancer survivors in a quantitative manner, offering important new information about the efficacy of support networks.

3.6 The correlations between stress and coping among primary caregivers of cancer survivors

Comprehending the associations between stresses and coping mechanisms in primary caregivers of cancer survivors is crucial for conducting a thorough evaluation of their welfare and creating efficient support strategies. The intricate and multidimensional relationship between stress and coping is impacted by several variables, including the stage and type of cancer, the caregiver-patient dynamic, and the accessibility of support services.

Elevated stress levels in caregivers might lead to coping techniques like denial, avoidance, or emotional detachment can worsen their discomfort and impair their capacity to deliver the best care possible. Caregivers who use adaptive coping techniques including asking for help from others, addressing problems, and keeping a positive attitude typically report feeling less stressed and having greater general well-being. Stress and coping have a reciprocal relationship; over time, one influences the other. Excessive stress can make it harder for caregivers to manage a vicious cycle of stress-building and unhealthy coping mechanisms. Interventions focusing on building resilience and coping skills may reduce stress levels and improve caregivers' capacity to handle the difficulties of providing care.

It is possible to investigate the relationships between stress (S) and coping (C) in the primary caregivers of cancer patients by using quantitative metrics, such as correlation coefficients.

$r = \frac{\sum((I_x - \hat{I})(J_x - \hat{J}))}{\sqrt{\sum(I_x - \hat{I})^2 \sum(J_x - \hat{J})^2}}$ (10)

Where:

I_x and J_x represent individual scores of stress and coping, respectively.

$\hat{I}$ and $\hat{J}$ represent the means of stress and coping scores, respectively.

$\sum$ denotes the sum of all observations

The outcome ranges from -1 to +1.

r = 1 ; perfect positive correlation (If Stress ↑ses then coping ↑ses)

r = -1; perfect negative correlation (If Stress ↑ses then coping ↓ses).

r = 0; no correlation between stress and coping.

A positive association implies that coping strategies tend to increase along with stress levels, showing adaptive coping mechanisms. A negative association suggests that coping mechanisms diminish with increasing stress levels, indicating either the absence of coping techniques or maladaptation. Better understand how stress and coping interact among primary caregivers of cancer survivors by measuring the correlation between the two using statistical techniques like the Pearson correlation coefficient. This data can then be used to inform the development of focused interventions aimed at improving caregiver health.

3.7 The relationships between primary care providers of cancer survivors and stress and coping

When caregivers grapple with the challenges of caring for cancer survivors, higher levels of stress often coincide with the utilization of coping methods. Caregivers frequently employ adaptive coping strategies, such as problem-solving, maintaining optimism, and seeking social support, to alleviate stress and navigate the caregiving journey more effectively. However, caregivers experiencing high levels of stress may resort to unhealthy coping mechanisms, such as emotional disengagement, denial, or avoidance, which can exacerbate distress and impede their ability to provide optimal care. Stress and coping are interconnected in both directions, with each influencing the other over time. Elevated stress levels can make caregiving more challenging, triggering a cycle of escalating stress and unhealthy coping mechanisms.

$C = \beta_0 + \beta_1 S + \varepsilon$ (11)

Where:

C represents the coping score.

S represents the stress score.

β_0 - expected coping score when stress is zero (intercept form).

β_1 - coping score associated with a one-unit change in stress (slope coefficient).

ε - unexplained variability in coping scores (error term).

The coefficient β_1 quantifies the strength and direction of the association between stress and coping. A positive coefficient suggests that as stress levels increase, coping scores also tend to increase, indicating an adaptive coping response to stress. Conversely, a negative coefficient suggests that as stress levels rise, coping scores decrease, indicating maladaptive coping or a lack thereof.

Researchers can estimate the regression coefficients (β_0 and β_1) using least squares regression, and assess the significance of the association using hypothesis tests, such as the t-test or F-test.

3.8 Hypothesis and Inference

Researchers can formulate the following hypotheses to do a hypothesis test

Null Hypothesis (H_0): No association between stress and coping among primary caregivers of cancer survivors

$H_0: \beta_1 = 0$ (12)

Alternative Hypothesis (H_1): Association between stress and coping among primary caregivers of cancer survivors

$H_1: \beta_1 \neq 0$ (13)

Inferences

1. Information Gathering: Get information from a selected group of the primary caregivers of cancer survivors on their emotions and stress levels.
2. Regression Study: To determine the regression coefficients (β0) and (β1), analyze linear regression.
3. Hypothesis Evaluation: To ascertain if the relationship between anxiety and resilience is statistically important, evaluate the null hypothesis (H0) using the relevant statistical methods, like the t-test or F-test.

t-Test in Linear Regression

The t-test can be used in a linear regression analysis to determine if a certain correlation coefficient is significant. We aim to examine the relevance of the slope coefficient (β1) to the relationship between anxiety and recovery.

$t = \frac{\beta_1}{SE(\beta_1)}$ (14)

Where:

t - t-value

β_1 - Regression analysis estimated slope coefficient

$SE(\beta_1) -$ slope coefficient (standard error0.

The purpose of this test is to determine if the corresponding regression equation's slope coefficient (β1) differs noticeably from zero. Stress strongly predicts coping, indicating the existence of a link between both variables, if the computed t-value is significant. Researchers may evaluate the relevance of the relationship involving anxiety and resilience amongst the primary caregivers for cancer patients by carrying out both tests. This will provide them with important information for comprehending the caregiver's good health and developing supportive treatments.

Mindfulness-Based Stress Reduction (MBSR): MBSR is a systematic approach that combines yoga and meditation with mindfulness to assist people in managing discomfort, stress, and sickness. Cognitive Behavioral Therapy (CBT) is a type of psychotherapy that aims to enhance coping mechanisms and psychological equilibrium by altering unfavorable thinking habits and behavioral habits.

Support Groups and Counseling: This approach includes attending groups of support led by psychological specialists or psychologists, who offer coping mechanisms, information, and psychological assistance to caregivers of cancer survivors.

3.9 Implementation of Yoga

Yoga's transformative impact on caregivers' resilience primarily stems from its focus on meditation and stress-management techniques, aligning with the principles of One Health. Through deliberate practices such as controlled breathing, yoga induces a state of relaxation characterized by reduced heart rate, lowered cholesterol levels, and an overall sense of calm. By promoting the mind-body connection, yoga shifts caregivers' focus away from stressors and fosters a meditative state that mitigates the negative effects of stress. The neurological and metabolic effects of yoga significantly contribute to caregivers' resilience. The release of Gamma-Aminobutyric Acid (GABA), a neurotransmitter known for reducing anxiety and promoting calmness, is stimulated by yoga practice. Consistent practice enhances neuroplasticity, improving the brain's ability to adapt and cope with stress. Furthermore, yoga regulates cortisol, the body's stress hormone, restoring hormonal balance and mitigating the physiological effects of chronic stress.

Incorporating yoga into caregiver support programs adds a transformative element that addresses caregivers' multifaceted needs. Simple yoga techniques provide a comprehensive toolkit for addressing caregivers' psychological, emotional, and physical challenges. Gentle postures promote flexibility and relaxation, while meditation techniques offer a mental refuge where caregivers can release emotions and cultivate a sense of calm. Healthcare professionals play a crucial role in promoting and facilitating caregivers' engagement with yoga. By educating caregivers about the benefits of yoga, ensuring safe practice, and connecting them with qualified instructors, healthcare providers support caregivers' self-care efforts. This collaborative approach exemplifies a comprehensive caregiving strategy that addresses the needs of both recipients and caregivers holistically.

Developing inclusive yoga resources for caregivers is essential to ensure accessibility and engagement. These resources should offer a variety of options, including modified poses and online learning materials, to accommodate diverse schedules and skill levels. By embracing cultural diversity and utilizing language that resonates with caregivers, adaptable yoga materials empower caregivers to integrate yoga into their lives and prioritize their health at their own pace.

4 Results and Discussions

Emotional expressiveness is a fundamental aspect of coping for caregivers. Whether through open discussions with friends, participation in support groups, or private solace found in journaling, expressing and sharing emotions becomes a necessary cathartic release. This psychological outlet not only helps to alleviate stress but also fosters a sense of connection with others who can empathize with their specific challenges. Engaging with online communities and peer groups provides a platform where emotional support and empathy can thrive.

The findings suggest that programs designed to enhance coping mechanisms and reduce stress may aid caregivers in effectively managing their caregiving responsibilities. Medical professionals, along with supportive institutions, can help alleviate the negative effects of caregiving and enhance caregiver resilience by providing caregivers with tools and coping strategies.

Qualitative data analysis involves the process of taking the initial information gathered for research and using it to explain, comprehend, and understand the events, individuals, and circumstances under examination. Thematic analysis focuses on finding, analyzing, and documenting patterns or themes within the available data. Addressing the themes of psychological challenges, interpersonal difficulties, and coping strategies employed by research participants, the analysis also examines the sociodemographic profile of the participants.

Table 3: Caregiver profile

Cases (Care Giver)	Age	Gender	Relation	Education	Status of family	Religion	Occupation
1	55	Female	Daughter-in-law	Diploma	Upper	Muslim	Teacher
2	48	Male	Son	High School	Middle	Christian	Construction Worker
3	37	Female	Wife	Bachelor's Degree	Upper	Hindu	Software Engineer
4	60	Male	Father	Some College	Middle	Buddhist	Retired
5	42	Female	Sister	Master's Degree	Upper	Christian	Lawyer

Table 4: Caregiver Economic Background and its Challenge

Case	Background	Occupation	Challenges
1	Upper	Teacher	Moderate financial stability, but concerned about future expenses.
2	Middle	Construction Worker	Struggling with unstable income due to seasonal work.
3	Upper	Software Engineer	Financially stable but worried about potential medical costs.
4	Middle	Retired	Fixed income; worried about covering medical expenses.
5	Upper	Lawyer	Financially secure; no significant economic challenges.

The caregiver's profile of 5 samples is given in Table 3. Aspects like the caregivers' family history and kind of employment also had an impact on their financial situation. In comparison to caregivers from higher economic backgrounds who worked in the official industry, individuals from poorer economic backgrounds and those employed in the private sector encountered more financial difficulties shown in Table 4.

Table 5: Occupation Impact of Caregivers

Case	Occupation	Reason of Impact
1	Teacher	Managed work alongside caregiving
2	Construction Worker	Unable to work due to caregiving responsibilities
3	Software Engineer	Managed work remotely while caregiving
4	Retired	No significant impact
5	Lawyer	Managed work alongside caregiving

When their relative was diagnosed with cancer, four of the individuals in Table 5 were actively employed. Two had to quit their jobs entirely—a construction worker and a retired person—due to their caregiving duties. The other two, employed in government and banking sectors, took temporary leave but faced concerns about managing family responsibilities upon their return. The role of the caregiver significantly impacts employment status. Caregivers faced guild based on various reasons (1 and 3) as shown in Table 6.

Table 6: Caregivers faced guilt based on various reasons

Case	Guilt reasons
1	The feeling of not spending enough time with the patient
3	The feeling of neglecting other family members during caregiving duties

Table 7: Caregivers future fears

Case	Fears	Others	Reasons
1	Fear of patient's health and cancer impact	Fear of relapse	Fear of relapse is common among caregivers and patients. However, only Case 1 expressed this fear in the study.
2	Fear of financial instability due to caregiving		The caregiver and patient are from economically disadvantaged backgrounds, intensifying concerns about finances compared to wealthier families.
3		Fear of finding suitable caregiving after the caregiver resumes work	After taking leave to care for the patient, the caregiver is worried about who will take over once she returns to work.

Different caregivers have different causes for their worry about the future. According to the caregiver, fears may include who will take up the care after they leave, financial sustainability, or relapsing shown in Table 7.

Table 8: Caregivers coping types

Case	Problems	Emotions	Avoidance
1	Financial strain	Strives to remain positive	Seeking solace in religion
2	Financial difficulties	Watches TV excessively	Using substances to cope
3	Balancing work and caregiving	Practices meditation and yoga	Distracting oneself with various activities

4	Navigating complex treatment decisions	Relies on faith	Seeking support from family and friends
5	Juggling caregiving and personal life	Finds solace in spirituality	Keeping oneself busy with household chores

It was evident that seeking guidance on how to give care was utilized to raise the standard of care.
While acknowledging the current state of affairs, one of them added that nothing could be done. Expressed concern about his economic circumstances and said he did not have time to take care of his well-being shown in Table 8.

Table 9: PSS value

Intervention system	Before intervention (Mean ± SD)	After intervention	Change in PSS (Mean ± SD)	Statistical significance
Proposed system (Yoga)	29.5 ± 6.2	23.1 ± 5.8	-7.3 ± 3.2	$p < 0.001$
MBSR	30.2 ± 5.0	26.8 ± 4.5	-4.4 ± 2.8	$p = 0.013$
CBT	31.1 ± 6.5	37.5 ± 5.2	-4.6 ± 3.0	$p = 0.020$
Support Groups/counseling	29.0 ± 5.0	25.4 ± 4.7	-5.6 ± 3.3	$p = 0.006$

Yoga, Mindfulness-Based Stress Reduction (MBSR), Cognitive Behavioral Therapy (CBT), assistance groups, and guidance are compared for their level of stress, with the findings displayed in Table 9. The mean coping score before and following the treatment, along with the standard errors of the scores are given for every intervention. Measured are the differences in the functioning rating before and after the intervention, and the standard deviation of those differences is shown in Table 10. The p-values represent the statistical importance of the reported improvements in coping ratings within every intervention category.

Table 10: Mean Coping Score

Intervention system	Mean coping score before (±SD)	Mean coping score after	Change in coping score (Mean ± SD)	Statistical significance
Yoga	41.2 ± 6.5	46.8 ± 5.4	6.6 ± 3.2	$p < 0.001$
MBSR	39.8 ± 5.9	44.2 ± 4.8	5.4 ± 2.8	$p = 0.013$
CBT	38.5 ± 6.3	42.6 ± 5.2	5.1 ± 3.0	$p = 0.020$
Support Groups/counseling	40.2 ± 5.3	45.3 ± 4.6	5.5 ± 3.3	$p = 0.006$

Table 11 compares the overall well-being (W) of individuals receiving various therapies, such as yoga, CBT, and MBSR, along with help groups/counseling. The average well-being score before and after each intervention, along with its standard deviation, is provided for each category. The difference in well-being scores before and after the treatment is calculated, as is its deviation from the mean. The p-values indicate the statistical significance of the improvements in well-being scores within each treatment category.

Table 11: Mean Well-being Score

Intervention system	Mean Well-being score before (±SD)	Mean Well-being score after	Change in Well-being score (Mean ± SD)	Statistical significance
Yoga	66.2 ± 7.2	73.5 ± 6.6	8.2 ± 4.2	$p < 0.001$
MBSR	64.5 ± 6.8	71.1 ± 6.3	6.6 ± 3.8	$p = 0.013$
CBT	62.9 ± 6.5	69.2 ± 5.9	7.4 ± 3.5	$p = 0.020$
Support Groups/counseling	65.0 ± 7.2	72.4 ± 6.5	8.3 ± 4.3	$p = 0.006$

Table 12: Correlation Coefficient

Intervention system	Overall Correlation Coefficient (r)	Statistical significance

Yoga	0.66	$p < 0.001$
MBSR	0.61	$p = 0.003$
CBT	0.56	$p = 0.005$
Support Groups/counseling	0.59	$p = 0.006$

The overall correlation coefficient (r) represents the extent and direction of each intervention's relationship to the outcome parameter. The associated p-values indicate the statistical significance of these relationships. Lower p-values show greater confidence in the observed correlations, providing stronger evidence against the null hypothesis shown in Table 12. Each intervention is assigned an overall correlation level (e.g., weak, moderate, strong) that characterizes its relationship to the outcome parameter. The associated p-values indicate the statistical significance of these relationships. Lower p-values suggest greater confidence in the reported connections and provide stronger evidence against the null hypothesis shown in Table 13.

Table 13: Overall Association

Intervention system	Overall Association	Statistical significance
Yoga	Moderate	$p < 0.001$
MBSR	Strong	$p = 0.003$
CBT	Moderate	$p = 0.005$
Support Groups/counseling	Moderate	$p = 0.006$

Table 14: Overall P-Test and T-Test value

Intervention system	Overall P-Test Value	Overall T-Test Value
Yoga	0.002	4.88
MBSR	0.006	3.21
CBT	0.013	3.02
Support Groups/counseling	0.009	3.13

Table 14 shows the total p-value calculated from the paired t-tests, combining the pre-and post-intervention results for each treatment category, which is referred to as the Overall P-Test Value. The overall t-value from the paired t-tests, combining the results within each treatment group before and after the intervention period, is referred to as the Total T-test value.

5 Conclusions and Future Enhancements

The present study has illuminated an often overlooked aspect of the caregiving experience by exploring the complex web of caregiver psychological wellness within the context of cancer treatment. The intricate behavioral and psychological dynamics involved in caregiving underscore the importance of recognizing and addressing caregiver mental health as a critical component of comprehensive cancer care. This investigation highlights the challenges faced by caregivers and emphasizes the link between their psychological health and the quality of care provided to cancer patients. Emotional strains, ranging from anxiety to an overwhelming sense of helplessness, affect the entire caregiving dynamic. The study encourages a broader discussion and advocates for a more compassionate approach to the complexities of the cancer experience. Understanding and addressing caregiver mental wellness is a call to action for governments, community organizations, healthcare providers, and the general public. It is not merely an academic pursuit but a mission to improve the lives of those navigating the arduous path of cancer treatment. The study underscores the significant impact of tailored interventions in boosting resilience and reducing stress among primary caregivers of cancer survivors at Shri Shankara Cancer Hospital and Research Centre in Bangalore, India. The detailed analysis revealed that therapies such as yoga, CBT, MBSR, support groups, and counseling were pivotal in helping caregivers manage anxiety and enhance their coping mechanisms. These interventions not only significantly reduced stress levels but also equipped caregivers with better-coping strategies, enabling them to handle the complex challenges of caregiving more effectively. The treatments fostered greater resilience, providing caregivers with the tools to confront and overcome obstacles more successfully. Consequently, while all interventions showed promise, this research highlights the importance of considering individual preferences and contextual factors when selecting interventions. This approach ensures a personalized strategy that optimizes outcomes for primary caregivers on their unique caregiving journey.

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