

# THE IMPACT OF STRESS ON THE IMMUNE SYSTEM OF CANCER PATIENT

**CHAITANYA PAWAR**

POST GRADUATE STUDENT (MMS)  
JAIN DEEMED-TO-BE UNIVERSITY, BANGALORE.

**AREES JAVAID**

POST GRADUATE STUDENT (MMS)  
JAIN DEEMED-TO-BE UNIVERSITY, BANGALORE.

**DR. PATCHABHJANGA RAO**

PROFESSOR & FACILITATOR,  
JAIN DEEMED-TO-BE UNIVERSITY, BANGALORE

## ABSTRACT

*Understanding the connection between stress and cancer is particularly important as anxiety and depression are highly prevalent in patients with cancer. Cancer diagnosis and treatment may cause symptoms that meet the full clinical criteria of post-traumatic stress disorder in up to ~20% of total cases and can lead to long-term alterations in neuroendocrine circuitries. Surgery-related stress has been shown to cause an excess release of catecholamines and prostaglandins perioperatively in patients with cancer, which can promote metastatic progression. Despite the lack of proof that stress causes cancer in humans, there is convincing epidemiological evidence that objective stressors and self-evaluated psychological distress correlate with negative cancer outcomes (progression, metastasis, recurrence, therapeutic failure and increased mortality). Adverse life circumstances in general have been closely associated with a skewing towards pro-inflammatory responses and can dampen antiviral activity in circulating leukocytes. These changes have largely been attributed to glucocorticoid-related pathways and the activation of the adrenergic system. Moreover, gene signatures indicative of the activity of the glucocorticoid, adrenergic, dopaminergic, serotonergic and muscarinic systems have been closely correlated with unfavourable outcomes in patients with prostate cancer.*

*The adverse effect of stress on cancer outcomes has been replicated in mouse models, allowing to establish causality and to explore the underlying mechanisms. Repeated restraint, male domination or unpredictable chronic mild stress are established procedures to induce stress in rodents. These have been shown to cause behavioural, psychological and biological changes that promote tumour development, metastatic dissemination and therapeutic failure in mice. Moreover, mice held in standard housing conditions are already stressed and alleviating stress by shifting them from the hypothermic to thermoneutral conditions or placing them in an 'enriched' environment can significantly reduce tumour growth.*

**KEYWORDS:** *Chronic Stress, Hypothalamic-Pituitary-Adrenal Axis, Tumor Microenvironment, Immunity, Stress Management*

---

## INTRODUCTION:

Stress also known as psychological stress describes what people experience when they are under mental, physical, or emotional pressure. Stressors factors that can cause stress—can arise from people's daily responsibilities and routines, including work, family, and finances. Other stressors include external factors such as early life adversity, exposure to certain environmental conditions, poverty, discrimination, and inequities in the social determinants of health. Serious health issues, such as a cancer diagnosis in oneself or a close friend or family member, can also cause stress. The body responds to external stressors by releasing stress hormones (such as epinephrine and norepinephrine) that increase blood pressure, heart rate, and blood sugar levels. This response, often referred to as the fight-or-flight response, helps a person act with greater strength and speed to escape a perceived threat. Although the fight-or-flight response helps the body manage momentary stress, when this response is caused by long-term, or chronic, stress it can be harmful. Research has shown that people who experience chronic stress can have digestive problems, heart disease, high blood pressure, and a weakened immune system. People who experience chronic stress are also more prone to having headaches, sleep trouble,

difficulty concentrating, depression, and anxiety and to getting viral infections, including SARS-CoV-2, the virus that causes COVID-19.

## REVIEW OF LITRATURE:

A literature review on the impact of stress on the immune system of cancer patients explores the complex interplay between psychological stress and the body's immune response in individuals diagnosed with cancer. Stress can have a profound effect on the immune system, and this interaction may have implications for cancer progression and treatment outcomes.

**Yuting Ma 2023 Oct 13** Stress is linked to cancer outcomes, although it doesn't directly cause cancer in humans. Psychological distress can lead to negative cancer outcomes, such as progression and therapeutic failure. Stress-related factors like glucocorticoids and catecholamines can affect cancer cells, promoting proliferation, resistance, and metastasis in mice. Stress can also reshape the tumour environment. In mouse models, stress has been shown to induce behavioural, psychological, and biological changes that promote tumour development. Stress reduction in mice, through improved living conditions, can reduce tumour growth. The effects of stress on cancer involve neuroendocrine factors that influence both cancer cells and the tumour microenvironment. Stress-induced factors can impact immune cells and anticancer responses.

**Leyi Zhang, Jun Pan, and Jian Huang 2020:** Psychological stress is a well-accepted risk factor in cancer initiation and progression. The explosive growth of psychoneuroimmunology research in the past decade has yielded an unprecedented wealth of information about the critical role of chronic stress in the immune dysfunction that influences tumour behaviours, which presents insights to mitigate distress and improve prognosis in cancer patients. Chronic stress exacerbates inflammation and causes a metabolism disorder, making it difficult for the organisms to maintain homeostasis and increasing its susceptibility to cancer. The shifted differentiation and redistribution of the immune system induced by chronic stress fail to combat cancer efficiently. Chronic stress increases the tumour-educated immune suppressive cells and impairs the cytotoxicity of cellular immunity, thereby promoting lymphatic metastasis and hematogenous metastasis. In addition, the efficacy of existing cancer therapies is undermined because chronic stress prevents the immune system from responding properly. Emerging stress-reduction measures have been administered to assist cancer patients to cope with the adverse effects of chronic stress. Here we systematically review the current molecular, cellular, physiological mechanisms about stress-mediated immune responses in the enhancement of tumour initiation and progression, remodelling of tumour microenvironment and impairment of anti-tumour treatment. We also summarize the potential clinically applicable stress-oriented strategies towards cancer and discuss briefly where important knowledge gaps remain.

**Michael H Antoni , Firdaus S Dhabhar: 2019:** The range of psychosocial stress factors/processes (e.g., chronic stress, distress states, coping, social adversity) were reviewed as they relate to immune variables in cancer along with studies of psychosocial interventions on these stress processes and immune measures in cancer populations. The review includes molecular, cellular, and clinical research specifically examining the effects of stress processes and stress-management interventions on immune variables (e.g., cellular immune function, inflammation), which may or may not be changing directly in response to the cancer or its treatment. Basic psychoneuroimmunology research on stress processes (using animal or cellular/tumour models) provides leads for investigating biobehavioural processes that may underlie the associations reported to date. The development of theoretically driven and empirically supported stress-management interventions may provide important adjuncts to clinical cancer care going forward.

**DR. Michael H. Antoni, Ph.D.<sup>1</sup> and Firdaus S. Dhabhar, Ph.D. : 2019:** Stress is a significant factor in cancer diagnosis, treatment, and survivorship. It affects tumour development and metastasis through immune and non-immune mechanisms. Stress is a response to internal or external challenges, involving the release of stress hormones like norepinephrine, epinephrine, and cortisol. Short-term stress can be adaptive, but chronic stress can be harmful, especially when it disrupts the circadian cortisol rhythm and affects the glucocorticoid receptor. Individual differences, both genetic and environmental, influence how stress is perceived and its impact on the body, including immune cell function. Stress-induced elevations in stress hormones can affect immune responses and overall health outcomes.

**Shiur Dai, Yongzhen Mo, Yumi Wang, Bo Xiang, Tianjin Liao, Ming Zhou, Xiaoling Li, Yong Li, Wei Xiong, Guiyuan Li, Can Guo, and Zhao yang Zeng: 2020:** Chronic stress hampers the immune system, particularly T cells, by reducing the function of antigen-presenting cells (APC) and inhibiting Th1 responses, essential for cellular immunity against cancer. High stress hormone levels, such as glucocorticoids and epinephrine, suppress the immune response, impacting anti-tumour efforts. Stress hormones also activate the COX-2/PGE2 pathway in cancer cells, promoting inflammation and hindering tumour immunity by altering the tumour microenvironment, making it easier for tumour cells to evade the immune system.

**Fei Peng a 1, Jinxin Lu a 1, Bin He a, Qitong Su a, Huandong Luo a, Ziqian Liu : 2019** Chronic stress has significant effects on tumour development. It increases the allostatic load in the body, leading to health issues and promoting cancer progression. Stress hormones like epinephrine, norepinephrine, and glucocorticoids play a role in tumour growth and metastasis. Several therapeutic strategies, including  $\beta$ -adrenergic blockers and stress-specific target inhibitors, can help

counteract the effects of chronic stress on cancer. Additionally, psychotherapy, yoga therapy, music therapy, mindfulness training, and traditional Chinese medicine approaches can improve the quality of life for cancer patients, addressing both mental and physical side effects.

**Jennifer N. Morey, Ian A. Boggero, April B. Scott, and Suzanne C. Segerstrom : 2015** Stress affects the human immune system in various ways. Acute stress can mobilize immune cells and increase pro-inflammatory cytokines. Chronic stress, lasting from days to years, can lead to chronic inflammation and activation of latent viruses, potentially increasing the risk of chronic diseases. People who have experienced early adversity may be more susceptible to exaggerated immune reactions to stress. Understanding these connections is crucial for health and longevity, as chronic stress can accelerate cellular aging. Recent research explores these relationships, including stress's impact in early and late life, mediators, ecological factors, and clinical implications.

**Cambridge University Press: 2021 Anurag K. Singh Open the ORCID record for Anurag K. Singh, Udit Chatterjee, Cameron R., Elizabeth A. Repasky and Uriel Halbreich :Analysis of the literature related to the role of stress in cancer.** The study examined 47 articles from 2007 to 2020 on stress and cancer. Only 3 studies (6.4%) suggested a protective effect of stress, while 21 (44.6%) indicated a harmful effect on cancer incidence or mortality. The remaining 23 (48.9%) showed no clear association. Better linking perceived stress with measurable physiological changes, particularly on the immune system, may improve understanding of these associations. Positive psychological traits were linked to reduced HPA reactivity, and research suggests that chronic social stress can affect immune function.

**Kamir J. Hiam-Galvez, Breanna M. Allen & Matthew H. Spitzer 2021 august:** Recent studies highlight the impact of surgical tumour removal on the immune system and metastasis. Surgical procedures can trigger immunosuppressive myeloid cells, which may support metastatic growth. Tumour-specific T cell responses and NK cell activity can be weakened following surgery, promoting metastasis. However, successful primary tumour removal can restore normal immune function in some cases. Balancing the detrimental and beneficial effects of surgery on the immune system is crucial, and understanding how the cancer type and disease stage influence immune changes is essential. Combining conventional therapies with immune modulation can be a powerful approach to combat cancer, especially during the vulnerable period after surgery, which warrants further investigation.

**Marta Falcinelli, Premal H. Thaker, Susan K. Lutgendorf, Suzanne D. Conzen, Renée L. Flaherty, and Melanie S. Flint:2021** Stress can lead to dysregulated epigenetic mechanisms that impact cancer risk. Glucocorticoids, activated during stress, induce epigenetic changes such as DNA methylation and histone modification, potentially promoting cancer. Stress exposure during early development can increase cancer risk through lasting epigenetic modifications. Additionally, stress can disrupt immune and inflammatory processes, weakening the body's ability to recognize and destroy cancer cells. Stress hormones can suppress immune surveillance, enhance inflammation, and upregulate immunosuppressive signals, contributing to tumorigenesis. Stress also affects immune cell trafficking and promotes an environment favouring malignant cell transformation.

**Future Oncol. 2010** The article discusses the impact of psychosocial factors, such as chronic stress, on cancer progression, particularly metastasis. These psychosocial factors appear to play a more prominent role in cancer progression than in cancer initiation. The article also highlights the importance of addressing not only cancer cells but also host factors that contribute to metastatic cancer growth. Social support is mentioned as a potential buffer against the negative effects of stress. The article reviews the biological processes affected by chronic stress and their implications for cancer management. 63–1881.

**MARKHAM HEID 2014** Stress, whether short-term or chronic, can impact your health and may promote the growth and spread of certain diseases, including cancer. Chronic stress, which persists over weeks or months, can weaken your immune system and increase the risk of health issues. Chronic stress can also aid cancer growth in various ways, such as inhibiting the process that kills diseased cells and promoting the production of growth factors that support tumor development. While eliminating the source of chronic stress is ideal, it's not always possible. Therefore, learning to manage stress is crucial for maintaining your well-being. Managing stress can help prevent it from negatively affecting your health.

**Mahlagha Dehghan 2020** Cancer patients often experience stress and anxiety, which can affect their quality of life. Chronic stress may impact cancer progression. Mindfulness, a state of being present and fully engaged in the moment, can reduce stress and improve well-being. This research explores the relationship between stress, quality of life, and mindfulness in cancer patients. The findings suggest that perceived stress and mindfulness together predict changes in the quality of life. Mindfulness plays a mediating role in the connection between stress and quality of life. Understanding these relationships can highlight the importance of mindfulness in the lives of cancer patients, contributing to improved well-being highlight the importance of mindfulness in the lives of cancer patients, contributing to improved well-being.

**Nadia Jaber 2021** Some cancer treatments can induce dormancy in surviving cancer cells, making them undetectable with standard tests. Dr. Perego's research explored whether immune cells could awaken these dormant cancer cells. They found that certain immune cells, called pro-tumour neutrophils, were capable of reactivating dormant cancer cells. Stress hormones like adrenaline and norepinephrine were found to trigger a chain reaction involving neutrophils and dormant cancer cells, leading to their reawakening. This cascade of events involving stress hormones, neutrophils, and specific proteins can reawaken dormant cancer cells.

**Nadia Jaber 2021** : A recent study suggests that stress hormones may awaken dormant cancer cells, potentially leading to cancer recurrence. While research in mice has demonstrated this connection, it's important to note that stress alone doesn't guarantee cancer recurrence in humans, and multiple intermediate steps are involved. The study opens the door to further research on the impact of cancer therapies and stress on dormant tumour cells, potentially shedding light on new therapeutic approaches and the role of the nervous system in tumour growth.

**Article Brain, Behaviour, and Immunity 2021:** Chronic stress is known to have various physiological effects, increasing the risk of health issues, including cancer. Studies have shown a link between chronic stress and cancer progression, with stress promoting tumour development. Chronic stress can influence tumour proliferation, metastasis, genomic instability, and angiogenesis. This review delves into the specific mechanisms by which chronic stress hormones affect tumour development and the potential therapeutic strategies for mitigating stress-induced cancer progression. Chronic stress leads to the activation of the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system (SNS), resulting in elevated levels of glucocorticoids, epinephrine, and norepinephrine. These stress-induced hormones contribute to tumour initiation and progression. The review also discusses how hormones like prolactin, oxytocin, and dopamine play a role in cancer development under chronic stress conditions. Potential therapeutic strategies for managing stress-induced cancer progression include  $\beta$ -adrenergic blockers, inhibitors of stress-specific targets, and psychological interventions like psychotherapy, yoga therapy, music therapy, and mindfulness training. The review suggests that further research into these strategies is necessary. Overall, the relationship between chronic stress and cancer is complex, involving multiple physiological pathways. Understanding these mechanisms can help in developing effective interventions to mitigate the impact of chronic stress on cancer progression.

### OBJECTIVES :

1. To underline the influence of stress on cancer outcomes: Stress affects cancer patients and may alter cancer development, metastasis, and treatment results.
2. To establish the link between psychological stress and cancer: The book uses epidemiological research and mice models to tie stress to bad cancer outcomes.
3. To underline the necessity of stress management in cancer care: By describing the negative effects of stress on cancer patients and its probable involvement in therapeutic failure, the text may emphasise the importance of stress management and psychological support.
4. To introduce stress and its physiological consequences: The introduction defines stress, its sources, and its physiological effects, setting the scene for the stress-cancer conversation.
5. To promote awareness about the health effects of chronic stress: The text discusses heart disease, weakened immune systems, and mental health illnesses to emphasise the necessity of stress reduction.

### RESEARCH METHODOLOGY

#### Primary Data Collection:

##### Surveys/Questionnaires:

Primary data for our research was collected through the distribution of questionnaire among a representative sample. The questionnaire was designed to elicit specific information related to our research objectives.

##### Interviews

In-depth interviews were conducted with key stakeholders to gain valuable insights into the subject matter. The interviews were semi-structured to allow for flexibility and in-depth exploration of relevant topics.

##### Observations:

Primary data was gathered through direct observations of the phenomenon under study. This method allowed for real-time data collection, capturing nuances that may not have been apparent through other means.

#### Secondary Data Collection:

##### Published Sources:

Secondary data was gathered from a comprehensive review of relevant literature, including books, articles, and reports. This allowed us to build on existing knowledge and understand the historical context of how stress impact the immune system of cancer patients.

##### Unpublished Sources:

Internal documents such as memos, letters, and organizational reports were accessed to gather secondary data. These sources provided valuable insights into the internal workings and historical development of and also impact of stress on immune system of cancer patients .

Particulars		FREQUENCY	PERCENT
	ABOVE 30	23	74
	BELOW 30	8	26
	<b>TOTAL</b>	<b>31</b>	<b>100</b>
<b>GENDER</b>	MALE	15	48
	FEMALE	16	52
	<b>TOTAL</b>	<b>31</b>	<b>100</b>
<b>EDUCATION LEVEL</b>	DIPLOMA/GRADUATE	7	23
	POST GRADUATE	24	77
	<b>TOTAL</b>	<b>31</b>	<b>100</b>
<b>OCCUPATION</b>	WORKING	20	65
	STUDENTS	11	35
	<b>TOTAL</b>	<b>31</b>	<b>100</b>
<b>MARITAL STATUS</b>	Married	27	87
	Single	4	13
	<b>TOTAL</b>	<b>31</b>	<b>100</b>
<b>EMPLOYMENT STATUS</b>	FULLTIME/PART TIME	9	29
	SELF EMPLOYED/	4	13
	UNEMPLOYED	18	58
	<b>TOTAL</b>	<b>31</b>	<b>100</b>

**Online Databases:**

Utilizing online databases, we retrieved secondary data from reputable sources such as academic journals, government publications, and industry reports. This method facilitated access to a wide range of information relevant to our research.

**Government and Institutional Data:**

Official government and institutional data, including census data and surveys, were analysed to supplement our research. These secondary sources provided comprehensive and reliable data on demographic and socio-economic factors.

**DATA ANALYSYS :**

Both quantitative and qualitative approaches to analysis should be used. For the assessing survey and clinical evaluation data, statistical methods should be used. Utilize a questionnaire in order to get qualitative questionnaire data

**DEMOGRAPHIC FACTORS**

The statistics shown in the above frequency table are from a Research On Impact of stress on Immune system of cancer patients. The following is an interpretation of the findings

**AGE:** The majority of the participants (74 percent) in the research are above age of 30, suggesting that the emphasis of the study is mostly on adults or persons past their adolescent age .

**GENDER:** The study included a diverse sample of participants, with a nearly equal distribution of male (48 percent) and female (52 percent) respondents.

**EDUCATION:** The majority of participants have completed their Post-Graduation level of study (77 percent) while a considerable fraction has pursued Diploma /Graduation level Education(23 percent).

**OCCUPATION:** The participants are working professionals (65 percent) and students (35 percent).

**EMPLOYEMENT STATUS:** The study encompassed participants from diverse employment backgrounds, including full-time employees (29 percent), self-employed (13 percent) individuals, and those currently unemployed (58 percent).

**MARITAL STATUS:** Participants marital status was considered as part of the demographic information, covering a range of categories such as married (87 percent), single(13 percent).

**ANALYSIS****Emotional wellbeing has changed since being diagnosed with cancer**

S.NO	RESPONSES	FREQUENCY	PERCENT
1	Strongly Agree	14	43.8
2	Agree	12	37.5

3	Neutral	4	12.5
4	Disagree	2	6.3
	<b>Total</b>	<b>32</b>	<b>100</b>

### Interpretation

This indicates that a significant portion (43.8%) of the respondents strongly agree that their Emotional Well Being has changed since Being diagnosed with Cancer. The majority of respondents (81.3% - sum of "Strongly Agree" and "Agree") seem to be in agreement with the statement A smaller percentage (12.5%) remains neutral. A minority (6.3%) expressed disagreement.

### Respondents perception on Stress affecting significantly the daily life

S.NO	RESPONSES	FREQUENCY	PERCENT
1	Strongly Agree	14	43.8
2	Agree	11	34.4
3	Neutral	7	21.9
	<b>TOTAL</b>	<b>32</b>	<b>100</b>

### Interpretation

A significant portion (43.8%) of respondents strongly agrees that stress has a significant impact on their lives. This suggests a high level of acknowledgment or personal experience with stress affecting their daily lives. The second-highest percentage (34.4%) falls under the category of "Agree," indicating that a substantial number of respondents acknowledge the significant impact of stress on their lives. A smaller but still notable proportion (21.9%) of respondents chose the "Neutral" option. This suggests that there is a group who may not strongly feel that stress significantly affects their lives or are uncertain about its impact.

### My sleep patterns have changed since my cancer diagnosis due to stress

S.NO	RESPONSES	FREQUENCY	PERCENT
1	Strongly Agree	11	34.4
2	Agree	8	25
3	Neutral	9	28.1
4	Disagree	4	12.5
	<b>Total</b>	<b>32</b>	<b>100</b>

### Interpretation

A significant portion (34.4%) of respondents strongly agrees that their sleep patterns have changed since their cancer diagnosis due to stress. This suggests a substantial impact of stress on sleep for this group. The second-highest percentage (25%) falls under the category of "Agree," indicating that a notable number of respondents acknowledge changes in their sleep patterns due to stress. A significant proportion (28.1%) of respondents chose the "Neutral" option. This suggests that there is a group that is uncertain or does not strongly feel that stress has impacted their sleep patterns since the cancer diagnosis. A smaller but still noteworthy percentage (12.5%) of respondents disagree that their sleep patterns have changed due to stress since their cancer diagnosis.

### Respondent opinion on the social support during my cancer journey

S.NO	RESPONSES	FREQUENCY	PERCENT
1	Strongly Agree	9	28.1
2	Agree	10	31.3
3	Neutral	9	28.1
4	Disagree	3	9.4
5	Strongly Disagree	1	3.1
	<b>Total</b>	<b>32</b>	<b>100</b>

### Interpretation

The majority of respondents (59.4% - sum of "Strongly Agree" and "Agree") perceive social support during their cancer journey. A significant proportion (28.1%) is either neutral or undecided about their perception of social support. A smaller but still notable percentage (9.4%) of respondents disagree that they perceive social support during their cancer journey.

percentage (3.1%) falls under the category of "Strongly Disagree," suggesting a very small group of respondents who strongly feel that they lack social support during their cancer journey.

#### Agree that stress plays an important role in progression of cancer

S.NO	RESPONSES	FREQUENCY	PERCENT
1	Strongly Agree	12	37.5
2	Agree	14	43.8
3	Neutral	3	9.4
4	Disagree	3	9.4
	<b>Total</b>	<b>32</b>	<b>100</b>

#### Interpretation

37.5% of the respondents strongly agree that stress plays a role in the progression of cancer. This indicates a substantial portion of the participants hold a strong belief in the connection between stress and cancer progression. Another 43.8% of the respondents agree with the statement. Combined with those who strongly agree, a total of 81.3% of the participants are in agreement that stress has a role in the progression of cancer. This suggests a strong consensus among the majority of respondents. 9.4% of respondents chose the neutral option. This may suggest some uncertainty or lack of a clear opinion among a smaller portion of the participants. 9.4% of respondents disagree with the statement.

#### Stress has influenced changes in my dietary habits since my cancer diagnosis

S.NO	RESPONSES	FREQUENCY	PERCENT
1	Strongly agree	10	31.3
2	Agree	13	40.6
3	Neutral	6	18.8
4	Disagree	1	3.1
5	Strongly Disagree	2	6.3
	<b>Total</b>	<b>32</b>	<b>100</b>

#### Interpretation

31.3% of respondents strongly agree that stress has influenced changes in their dietary habits since their cancer diagnosis. This suggests a significant portion of participants strongly believe in the connection between stress and alterations in their eating pattern. An additional 40.6% of respondents agree with the statement. When combined with those who strongly agree, a total of 71.9% of participants acknowledge the influence of stress on changes in their dietary habits. This indicates a substantial majority that perceives a relationship between stress and dietary changes. 18.8% of respondents chose the neutral option. This may suggest a moderate proportion of participants who are unsure or do not strongly feel that stress has influenced their dietary habits since their cancer diagnosis. A small percentage, 9.4% in total, either disagree or strongly disagree with the statement. This implies a minority of participants who do not perceive a significant impact of stress on their dietary habits post-cancer diagnosis.

#### Respondents opinion on the experience of symptoms of stress, such as headaches, muscle tension, or fatigue.

S.NO	RESPONSES	FREQUENCY	PERCENT
1	Strongly agree	8	25
2	Agree	15	46.9
3	Neutral	6	18.8
4	Disagree	3	9.4
	<b>Total</b>	<b>32</b>	<b>100</b>

#### Interpretation

It appears that 25% of the respondents strongly agree that they frequently experience symptoms of stress, such as headaches, muscle tension, or fatigue. This suggests a significant portion of the participants are acknowledging a high level of stress-related symptoms. Almost half of the respondents (46.9%) agree that they frequently experience stress-related symptoms. This, combined with the "Strongly Agree" responses, indicates a substantial majority acknowledging the presence of stress symptoms. A smaller but still noteworthy proportion (18.8%) of respondents chose the "Neutral" option, suggesting some uncertainty or variability in their experiences of stress-related symptoms. A relatively small

percentage (9.4%) of respondents disagree that they frequently experience stress-related symptoms. This indicates that there is a minority who do not perceive themselves as frequently experiencing such symptoms.

#### The effectiveness of stress management programs or counselling in coping with the challenges of cancer

S.NO	RESPONSES	FREQUENCY	PERCENT
1	Strongly agree	9	28.1
2	Agree	14	43.8
3	Neutral	7	21.9
4	Disagree	2	6.3
	<b>TOTAL</b>	<b>32</b>	<b>100</b>

#### Interpretation

Approximately 28.1% of respondents strongly agree that a stress management program or counselling is effective in coping with the challenges of cancer. This suggests a significant proportion of participants strongly endorse the effectiveness of such interventions. A larger portion, 43.8%, agrees that stress management programs or counselling are effective in coping with cancer-related challenges. This indicates a substantial majority recognizing the positive impact of these interventions. About 21.9% of respondents chose the "Neutral" option, suggesting a considerable portion of participants are unsure or have a neutral stance regarding the effectiveness of stress management programs or counselling for coping with cancer challenges. A small percentage (6.3%) of respondents disagree that stress management programs or counselling are effective in coping with cancer challenges. This indicates a minority who do not see these interventions as effective.

#### The effectiveness of stress reducing activities such as meditation or exercise is improving My well-being.

S.NO	RESPONSES	FREQUENCY	PERCENT
1	Strongly agree	8	25
2	Agree	15	46.9
3	Neutral	6	18.8
4	Disagree	2	6.3
5	Strongly Disagree	1	3.1
	<b>TOTAL</b>	<b>32</b>	<b>100</b>

#### Interpretation

Approximately 25% of respondents strongly agree that engaging in stress-reducing activities like exercise and meditation is effective in improving their well-being. This suggests a substantial portion of participants strongly endorse the positive impact of these activities. A larger majority, 46.9%, agrees that stress-reducing activities are effective in improving well-being. This indicates a significant consensus among the respondents regarding the positive influence of activities like exercise and meditation on their overall well-being. About 18.8% of respondents chose the "Neutral" option, suggesting a portion of participants who may be uncertain or have a neutral stance regarding the effectiveness of stress-reducing activities in improving their well-being. A small percentage (6.3%) of respondents disagree that stress-reducing activities improve their well-being. This indicates a minority who do not see a clear positive impact from engaging in these activities. A very small portion (3.1%) of respondents strongly disagree that stress-reducing activities are effective in improving their well-being.

#### Stress has affected my adherence to cancer treatment plans prescribed by my healthcare provider

S.NO	RESPONSES	FREQUENCY	PERCENT
1	Strongly Agree	7	21.9
2	Agree	16	50
3	Neutral	5	15.6
4	Disagree	3	9.4
5	Strongly Disagree	1	3
	<b>TOTAL</b>	<b>32</b>	<b>100</b>



## Interpretation

About 21.9% of respondents strongly agree that stress has significantly affected their adherence to cancer treatment plans. This suggests a notable portion of participants acknowledging a strong impact of stress on their ability to follow the prescribed treatment. A majority, comprising 50%, agrees that stress has had an impact on their adherence to cancer treatment plans. This indicates a significant number of respondents recognizing the influence of stress on their ability to adhere to medical recommendations. A smaller but noteworthy proportion (15.6%) of respondents chose the "Neutral" option, indicating a level of uncertainty or variability in their perception of stress affecting adherence to cancer treatment plans. About 9.4% of respondents disagree that stress has affected their adherence to cancer treatment plans. This suggests a minority who do not perceive stress as a significant factor impacting their treatment adherence. A very small percentage (3%) of respondents strongly disagree that stress has affected their adherence to cancer treatment plans.

## CONCLUSION :

Chronic stress has negative effects on cancer development by impacting multiple cancer hallmarks and promoting inflammation, angiogenesis, and metastasis through neuroendocrine and immune system interactions. Stress management is important, but there are discrepancies between preclinical and clinical results due to various factors.

Key points for future studies include identifying which individuals benefit from stress interventions, determining the optimal timing for interventions (perioperative and adjuvant phases), and exploring combinations of stress management strategies. Personalized stress management may become an integral part of precision cancer therapy in the future.

## REFERENCES

1. Breslow, J. T., & Marder, S. R. (2019). History of psychopharmacology. *Annual Review of Clinical Psychology*, 15, 25–50.
2. Cruz-Pereira, J. S., et al. (2020). Depression's unholy trinity: dysregulated stress, immunity, and the microbiome. *Annual Review of Psychology*, 71, 49–78.
3. Hanahan, D., & Weinberg, R. A. (2000). The hallmarks of cancer. *Cell*, 100, 57–70. This review elegantly summarizes current knowledge about the links among depression pathogenesis, immunity, and the microbiome, as well as possible therapeutic interventions.
4. Hanahan, D., & Weinberg, R. A. (2011). Hallmarks of cancer: the next generation. *Cell*, 144, 646–674.
5. Veiga-Fernandes, H., & Artis, D. (2018). Neuronal-immune system cross-talk in homeostasis. *Science*, 359, 1465–1466.
6. Godinho-Silva, C., Cardoso, F., & Veiga-Fernandes, H. (2019). Neuro-immune cell units: a new paradigm in physiology. *Annual Review of Immunology*, 37, 19–46.
7. Huang, S., et al. (2021). Lymph nodes are innervated by a unique population of sensory neurons with immunomodulatory potential. *Cell*, 184, 441–459.e25. This study discovers that lymph node-innervating sensory neurons can interact with several predicted cell types and change their transcriptome, and the unexpected sensory neuro-immune circuit exhibits the capacity to monitor the inflammatory state in the lymph node.
8. Kabata, H., & Artis, D. (2019). Neuro-immune crosstalk and allergic inflammation. *Journal of Clinical Investigation*, 130, 1475–1482.
9. Chen, C.-S., Barnoud, C., & Scheiermann, C. (2021). Peripheral neurotransmitters in the immune system. *Current Opinion in Physiology*, 19, 73–79.
10. Guyot, M., et al. (2019). Apical splenic nerve electrical stimulation discloses an anti-inflammatory pathway relying on adrenergic and nicotinic receptors in myeloid cells. *Brain, Behavior, and Immunity*, 80, 238–246.
11. Al-Shalan, H. A. M., et al. (2019). Immunofluorescent characterization of innervation and nerve-immune cell neighborhood in mouse thymus. *Cell and Tissue Research*, 378, 239–254.
12. Jung, W. C., Levesque, J. P., & Ruitenberg, M. J. (2017). It takes nerve to fight back: the significance of neural innervation of the bone marrow and spleen for immune function. *Seminars in Cell & Developmental Biology*, 61, 60–70.
13. Zhang, X., et al. (2020). Brain control of humoral immune responses amenable to behavioural modulation. *Nature*, 581, 204–208. This well-designed study identifies a specific brain–spleen neural connection in mice that enhances humoral responses in response to an elevated platform regimen.
14. Rosas-Ballina, M., et al. (2008). Splenic nerve is required for cholinergic antiinflammatory pathway control of TNF in endotoxemia. *Proceedings of the National Academy of Sciences of the United States of America*, 105, 11008–11013.
15. Miyajima, M., et al. (2017). Metabolic shift induced by systemic activation of T cells in PD-1-deficient mice perturbs brain monoamines and emotional behavior. *Nature Immunology*, 18, 1342–1352. This paper reveals how the key immune checkpoint molecule PD1 is involved in regulating systemic metabolism, the biosynthesis of neurotransmitters and behaviors.