

Cognitive and Emotional Impact of Caregiving: Exploring Stress and Attention in Mothers of Children with Developmental

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Abstract: The paper has shown that chronic stress and anxiety can have a detrimental effect on cognitive capacity. Attention is a crucial cognitive skill that is necessary in many situations, whether they are related to work or personal life. The brain networks that are responsible for alertness, executive function, and orientation are all vulnerable to the harmful effects of long-term exposure to stress. This study aims to examine the impact of persistent psychosocial stress in real-world situations on a number of attention networks. The group that was stressed had quicker response times than the group that was not stressed, no matter what the aim and cue combinations were. Each side dealt with every situation with the same level of accuracy. There was no statistically significant difference between the two groups in any of the three measures that were used to evaluate attention networks. In the group that was stressed, a large positive association was discovered between the alerting and orienting networks, while a significant negative correlation was found between the two networks.

Keywords: Stress and Anxiety; Developmental Disorders; Intellectual Ability; Mental Health; Repetitive Behaviours; Health Consequences; Psychological Stress; Healthcare Systems.

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1. Introduction

Providing care for children with developmental disabilities is a particularly challenging responsibility that impacts carers’ physical, emotional, and psychological well-being [4]. This function generally necessitates addressing the complex and varied needs of children with cognitive impairments, including difficulties in communication and social interaction, as well as the management of repetitive behaviors and sensory sensitivities [1]. Mothers, as primary caretakers, often endure the majority of these tasks, resulting in chronic stress and its detrimental consequences on mental health and cognitive performance [11]. Stress, as defined in psychological literature, is any factor that interrupts the usual equilibrium of an individual’s life. Chronic stress, especially in carers, arises from prolonged exposure to stressors without sufficient recuperation opportunities [20]. Carers of children with developmental disorders encounter stressors such as meeting the child’s daily requirements, maneuvering through healthcare systems, balancing familial and social obligations, and addressing financial difficulties [21]. The aggregate effect of these stressors results in what is known as carer burden, a well-researched phenomenon linked to negative health consequences.

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Multiple studies have shown the harmful impact of chronic stress on cognitive function, especially attention and memory. These effects are often mediated by stress hormones, especially glucocorticoids, which derive from prolonged exposure to stressors [20]. Stress hormones harm brain regions important for executive function and emotional regulation — notably the prefrontal cortex and amygdala. Chronic stress can affect focus, judgment, and emotional control, which are important in effective caregiving [3].

Stress-induced cognitive impairment has been well-studied under controlled lab conditions [26]. However, among those experiencing chronic psychological stress, there is growing awareness of the need to understand these effects in real-world contexts. Parents of children with developmental difficulties are a separate target group [7]. The above unique conditions render them an important cohort for studying the functional link between chronic stress and cognition. This study aims to investigate the impact of prolonged stress associated with caregiving on the attention networks in the brain. Attention is a complex cognitive activity involving three interconnected networks: alerting, orienting, and executive control. The three networks, in their general terms, are the alerting network, which prepares to react to stimuli; the orienting network, which directs attention to specific spatial locations; and the executive control network, which integrates competing information and prioritizes responses. Understanding the impact of stress on these networks provides valuable information about the full cognitive consequences of the deformation process due to caregiving-related stress.

Conversely, the study aims to compare carers of children with developmental anomalies and typically developing youngsters for this goal. The study measured reaction times and accuracy on attention tests to explore potential differences in cognitive performance between these groups. This paper highlights the importance of assessing chronic stress to attention networks and whether these changes align with the stress level experienced by carers. Around the same time, using fMRI to examine neural processing of emotional information, other studies had already shown that chronic stress has a detrimental effect on cognitive control and selective attention. As chronic activation of the hypothalamic-pituitary-adrenal (HPA) axis occurs during stress, deficits develop in the prefrontal cortex, leading to issues with the ability to concentrate and disengage from aversive stimuli [26]. Additionally, stress-related changes in the amygdala and its connectivity with attentional networks may increase focus on potential threats while diminishing overall cognitive flexibility.

Under these conditions, caregivers of children with developmental disorders may experience particular cognitive challenges due to increased stress [5]. The constant need to pay attention and make quick decisions during daily parenting may drain cognitive resources, while ongoing stress can zap away even more. Research suggests that chronic stress might lead to adaptive changes in attention, including increased response times in some contexts. However, these modifications frequently impede precision and sustained cognitive well-being. This study advances information by investigating carers' cognitive responses in genuine caregiving environments rather than controlled laboratory settings. The research employs self-report tools such as the Perceived Stress Scale and objective evaluations of attention networks to extensively investigate the impact of caregiving-related stress on cognitive performance. The results have ramifications for understanding the cognitive strain of caregiving and creating customized interventions to improve carers' mental health and well-being.

The research highlights the need for comprehensive care to help carers of children with developmental disabilities. Tackling mental health concerns and cognitive issues calls for a mix of policy-related steps, collective care systems, as well as tailored therapeutic approaches. However, several challenges inherent to caring can be avoided through the development of resilience or provision for requirements -enabling carers to provide their children with the best possible care whilst maintaining physical and mental health. Raising children with developmental challenges involves difficulties surpassing the basic caregiving demands. Chronic stress in carers dramatically impacts their cognitive capacity, emotional well-being, and overall quality of life. This study aims to clarify the cognitive effects of caregiving stress, particularly on attention, and to advocate for effective and durable strategies to alleviate these problems. These initiatives augment our capacity to assist carers in their essential functions within families and society.

2. Review of Literature

The phenomenon of stress has been intensively studied for several decades, with researchers examining its implications across diverse scientific fields. The results have enhanced comprehension of the influence of psychological processes on physiological functions and overall well-being [6]. According to Stokes and Kite [30], stress denotes any element that disrupts the regular functioning of an organism. Moreover, the specific occurrence or object that induces stress is sometimes called a stressor. Sapolsky [23] characterizes a stressor as an external factor that disrupts homeostatic equilibrium, whereas the stress response encompasses the body's physiological and psychological processes to re-establish homeostasis. The transactional model of stress posits that a cognitive assessment process shapes our responses to stress. The appraisal process involves evaluating the perceived threat or necessity, known as the primary evaluation.

Additionally, it includes the assessment of an individual's perceived competence and available resources to manage a situation, along with the perceived importance of managing it, collectively referred to as secondary appraisal [8]. Extended periods of stress significantly impact attention and cognition in the short and long term. Fuentes and Campoy [10] found that the activities of beta-adrenergic receptors mostly cause immediate impacts. In contrast, the long-term effects occur gradually through changes in gene expression assisted by steroids. Numerous studies [28]; [12] have demonstrated that mild and acute stress positively influence attention. In high-stress situations, individuals frequently exhibit heightened focus on essential activities, therefore neglecting ancillary information. Liu's [13] study findings support the concept of attentional tunneling. Callaway and Dembo [2] evidenced the phenomenon of attentional tunneling in emotionally charged contexts, particularly anxiety. Nonetheless, when assessing the relevance of peripheral information for the current work, it is frequently observed that the tunneling process adversely impacts task performance [28].

Sapolsky et al. [24] revealed that glucocorticoids exhibit a biphasic impact on the brain. Additional research is warranted to explore the observed discrepancies in baseline and stress hormone levels, which can be attributed to the presence of two distinct types of glucocorticoid receptors, namely mineralocorticoid receptors (Type I) and glucocorticoid receptors (Type II). These receptors exhibit differential concentrations throughout various regions of the brain. The researchers noted in their investigation involving laboratory rats that the type II receptors play a significant role in neuronal degeneration inside regions such as the hippocampus and amygdala. Moreover, persistent exposure to catecholamines has been noted to affect these particular brain regions [16]. In conjunction with other limbic structures, the amygdala strongly connects with cortical and subcortical areas implicated in attentional processing. The amygdala's increased sensitivity to stress may lead to deficits in attention processing and affect other brain regions, including the prefrontal cortex (PFC), through repetitive stimulation. Lupien et al. [17] posit that persons experiencing chronic stress may have impairments in cognitive regulation, resulting in increased focus on environmental threats and challenges in redirecting their attention away from them. Macleod et al. [18] indicate that persons diagnosed with post-traumatic stress disorder (PTSD) prefer to concentrate on negative stimuli and struggle to allocate their attentional resources properly.

The study's results by Saklatvala [22] substantiate this claim. Their argument indicates that the continual activation of the hypothalamic-pituitary-adrenal (HPA) axis causes physiological decline, which inhibits prefrontal cortex (PFC) function. Thus, this facilitates an instinctive, emotion-driven reaction from the limbic system during the attentional process. According to the study conducted by Sarahian et al. [25], it has been hypothesized that stimuli that trigger fear are received more automatically and parallelly. According to Squire et al. [27], the emergence of a quick stressor can lead to attentional biases, which subsequently result in stress hormones that can further impair attentional processing. Based on the findings of Steckler and Holsboer [29] research, it is proposed that there may be a potential consequence of inadequate regulation of limbic activation and desensitization of the glucocorticoid receptor (GR). However, subsequent research has cast doubt on the previously described findings, revealing that participants in these trials intentionally redirect their focus from adverse stimuli.

Wolkowitz et al. [31] assert that parents of children with autism spectrum disorder (ASD) experience considerable and enduring stress compared to families without children with ASD. Research indicates that a substantial amount of stress experienced by individuals is linked to deficits and impairments related to autism spectrum disorder (ASD), encompassing difficulties in social communication and interaction alongside the manifestation of restrictive and repetitive behaviors. Furthermore, other social factors were identified as stressors for the parents. A study by Wolkowitz et al. [31] indicates a favorable correlation between the duration of care, the time spent with individuals, and the stress level experienced. Moreover, a correlation exists between the disease's strength, its symptoms, and the degrees of stress encountered. Prior studies have demonstrated that some parents face challenges in their marital relationships and experience dissatisfaction in their marriages, intensifying their overall experiences. Wolkowitz et al. [31] assert that parents of children with neurodevelopmental disorders (NDD) have insufficient social support from their networks, resulting in exacerbated adverse effects. A significant difference exists in the impact of stress, demonstrated by elevated levels of depression and isolation in parents with an external locus of control.

Chronic stress has been linked to cognitive and health concerns and an expedited aging process [19]. Individuals experience repeated activation of numerous stress responses due to persistent exposure to a range of stressors in their lives, such as the features of their child, limited social and family support, financial burdens, and other socio-demographic issues. Chronic stress can lead to extended exposure to glucocorticoids (GC), downregulating glucocorticoid receptors (GR). This downregulation can lead to dysfunctions in memory, cognitive functioning, and other processes that involve the networks needed for a functioning normal population. Such weaknesses could also lead to poor performance in work and other important areas of life. Cognitive impairments in areas such as memory and learning, among others, limit human performance in many personal and occupational settings; thus, examining chronic stressors in real-world contexts allows for a better understanding of their effects.

3. Methodology

This study investigated the effect of caregiving-related stress on attention networks in mothers whose children suffered cognitive developmental disabilities. The data was collected from a cohort of 65 respondents, mostly mothers of CI-affected children. Participants were recruited from the outpatient services of a mental health facility assisting Syrian refugees in Turkey. They were intentionally selected due to their specific socio-environmental factors, leading them to experience unique caregiving difficulties.

To minimize confounding effects, the investigation was performed in a non-stimulated state free of stimulants such as tobacco or caffeine. A brief overview of the study's purpose, design, and expected outcomes was provided to each participant. All participants were given informed consent to ensure voluntary participation and compliance with ethical research protocols. To qualify for inclusion in this analysis, participants underwent an extensive screening performed by a credentialed psychiatry professional. This included assessments of any pre-existing psychiatric disorders or disabilities that might affect the interpretation of results. The sample in the study only included mothers who were their child's primary caretakers, which allowed for a more focused exploration of care-related stress. After the initial screening, participants used two validated measures of stress.

- The Perceived Stress Scale (PSS) evaluated participants' general stress level, which gives an idea of their whole psychological state.
- Parental Stress Scale (PSS-10) is a 10-item scale on the specific stresses associated with caregiving responsibilities.

Since participants varied in experience and familiarity with digital methods, both scales were administered traditionally on paper. Stress levels were measured from the collected data, and the potential impact on cognitive functions (attention, reaction speed) was investigated. The latter approach was employed so that the study could gain an extensive view of the impact of caregiving-related stress on cognition and emotions by concentrating on mothers since mothers often are the ones providing care. This process ensured careful screening, ethical compliance, and standardized measures to provide reliable and meaningful results.

4. Result and Discussions

In this study, the fundamental demographic characteristics of the final sample are investigated, and the results obtained from the administration of the self-report stress questionnaires, specifically the Perceived Stress Scale (PSS) and the Perceived Stress Scale-10 (PSS-10) between the questionnaires filled out by parents of children with cochlear implants who were in the stressed group and those who were not in the stressed group. There was a clear and noticeable difference in the stress levels experienced. The socio-demographic details of the respondents are represented in Table 1.

Table 1: Socio-Demographic Profile of the Respondents

Variable	Categories	Frequency (n)	Percentage (%)
Age	<30	15	23.1
	30-40	25	38.5
	40-50	18	27.7
	>50	7	10.8
Marital Status	Single	10	15.4
	Married	50	76.9
	Divorced/Widowed	5	7.7
Education	Primary	10	15.4
	Secondary	20	30.8
	Graduate	25	38.5
	Postgraduate	10	15.4
Occupation	Homemaker	35	53.8
	Employed	20	30.8
	Unemployed	10	15.4
Locale	Rural	15	23.1
	Urban	30	46.2
	Semi-Urban	20	30.8
Type of Family	Nuclear	25	38.5
	Joint	30	46.2

	Extended	10	15.4
Economic Status	Low Income	15	23.1
	Middle Income	35	53.8
	High Income	15	23.1
Health Issues	Yes	20	30.8
	No	45	69.2
Social Support	Adequate	25	38.5
	Inadequate	40	61.5

Insightful trends about the respondents are highlighted through the socio-demographic analysis (Table 1). Regarding the distribution of caregivers by age, most fall into the 30–40 (38.5%), followed closely by the aged 40–50 group (27.7%), which also shows that caregiving is largely a middle-aged affair. Caregivers aged 50 years old probably because caregiving is physically and emotionally demanding. The marital status data indicates that the vast majority of respondents were married (76.9%), which may suggest one contribution to the traditional nature of caregiving roles as being aligned with married women, potentially with support from a spouse. Even more, single caregivers (15.4%) and divorced or widowed people for another 7.7% means that those groups are probably not as involved as caregivers.

Education is especially noteworthy, showing a high level of education among the respondents, with 38.5% holding a graduate degree and 30.8% secondary education. Fewer have postgraduate education (15.4%), and only 15.4% are educated to primary level of schooling. This could indicate that caregiver education is associated with engagement in the healthcare system and success in caregiving tasks. The top category in the occupation data is homemaker, which closely follows (53.8%) and reflects caregiving role biases. Yet we have 30.8% working, combining caregiving with professional work, and at least 15.4% unemployed, which may depict an economic difficulty or that they cannot juggle both a job and caregiving. In a locale analysis broken down by Urban, Suburban, and Rural percentages, 46.2% of caregivers live in urban areas — perhaps with easier access to health care and mental health services. Among these, 30.8% of respondents were semi-urban caregivers, and 23.1% were rural, indicating possible geographic variability in caregiving experiences and access to resources for caregivers. These socio-demographic trends remind us of the complexity (varying factors interacting with varying responsibilities) of organizing caregiver roles.

Table 2: Comparison of Stress Levels and Cognitive Performance Between Stressed and Non-Stressed Groups

Variables	Stressed Group	Non-Stressed Group
PSS-10 Mean	21.3	10.9
PSS-10 SD	5.6	2.7
Parental Stress Mean	43.1	20.1
Parental Stress SD	7.5	2.1
Reaction Time Mean	570.12	585.45
Reaction Time SD	71.5	99.22
Reaction Time Mean	588.6	598.27
Reaction Time SD	75.8	107.44
Accuracy Mean	0.791	0.981
Accuracy SD	0.005	0.016
Accuracy Mean	0.787	0.977
Accuracy SD	0.007	0.018

The people experiencing high stress levels reported feeling a greater responsibility in caring for their children, impacting their overall health and well-being. On the Perceived Stress Scale-10 (PSS-10), the group experiencing stress demonstrated significantly higher levels of stress than the group not experiencing stress, with a mean score of 10.9 and a standard deviation of 2.7. The group experiencing stress had a mean score of 21.3 and a standard deviation 5.6. The parental stress scale reveals a significant disparity in the degrees of stress experienced by the parents. Compared to the group that did not experience stress (M = 20.1, SD = 2.1), the group that felt stress (M = 43.1, SD = 7.5) had higher scores. As of this point in the study, no further investigation into the demographic data was carried out. Information was gathered for the study regarding various aspects, such as the child's condition, the length of time the child was exposed to stress, the degree to which the spouse provided care, the participant's educational attainment, and their socio-economic circumstances. However, these aspects were not subjected to any additional investigation.

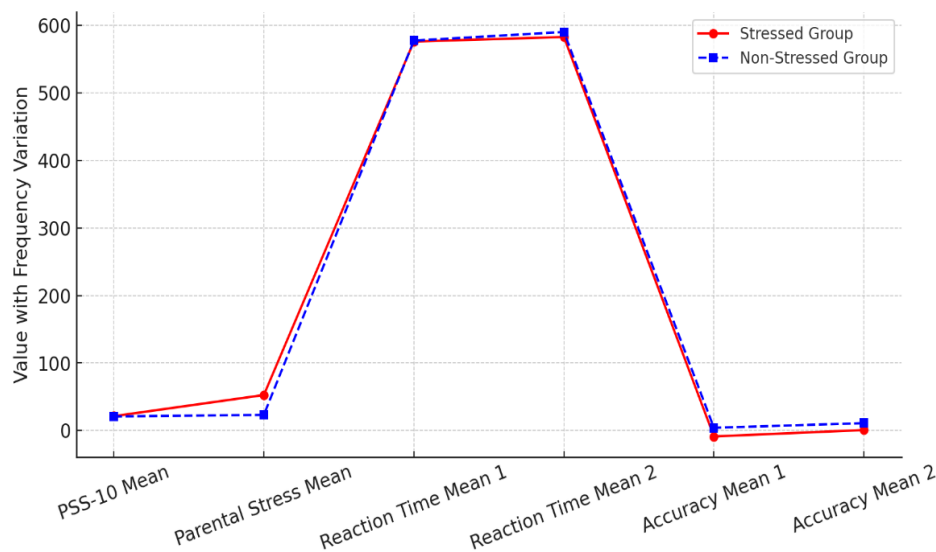


Figure 1: Comparison of Psychological and Cognitive Performance Metrics Between Stressed and Non-stressed Groups

The study also revealed information regarding the accuracy and reaction time of the stress groups and those that did not (Figure 1). Compared to the group that was not under stress, which had a mean reaction time of 591.863 and a standard deviation of 103.325, the group under stress had a much shorter reaction time (mean = 579.3643, standard deviation = 73.185). On the other hand, it is essential to point out that the group that was under stress (mean = 0.789, standard deviation = 0.006) and the group that was not under stress (mean = 0.979, standard deviation = 0.017) exhibited comparable levels of accuracy in terms of the overall accuracy. Table 2 provides information regarding accuracy and reaction time for two groups, especially those that were stressed and those that were not. The data is presented for two experimental circumstances, specifically congruent and incongruent, and it spans four cue conditions: no cue, center cue, double cue, and spatial. Two of the experimental conditions are mentioned above. When compared to the non-stressed group, the stressed group exhibited a significantly faster response time in all of the cue circumstances, and this was true for both the target condition and the non-stressed group.

The behavioral data demonstrate that the stressed group displays a comparatively quicker reaction time to target stimuli across all cue conditions than the non-stressed group. This finding contradicts the conclusions presented by Liu et al. [14]. The researcher assessed the attentional network's functionality on a cohort of physically and mentally healthy undergraduate students preparing for a postgraduate admission examination. The study's findings indicate that the group exposed to stress reduced reaction speed and accuracy relative to the group that encountered no challenges. It is essential to recognize that the two groups included in the current experiment had comparable levels of accuracy. The mothers of children with cerebral palsy in the stressed group demonstrated a markedly prolonged response time; however, this did not significantly affect their level of accuracy [15]. The prolonged response time observed in women from the stressed group may be linked to their continual need for heightened attention and attentiveness, which is crucial for caring for a child with a cognitive impairment. The present study has not thoroughly examined the effects of prolonged psychological stressors, such as caregiving for children with cognitive impairments, on the brain networks associated with cognitive functions like attention.

The present study elucidates the impact of acute and transient stressors on several cognitive abilities, including attention. A thorough examination of the impact of authentic and persistent psychological stressors on attention has not yet been conducted. This study aims to examine the effects of caregiving for children with neurodevelopmental disorders (NDD) on parental stress levels and the possible repercussions of this stress on the brain's attention networks. A study was performed in which the Attention Network Test (ANT) was given to parents of children diagnosed with Neurodevelopmental Disorders (NDD) and to parents of typically developing children (TD). The study analyzed the distinctions and commonalities between the two groups regarding their performance on the executive control, alerting, and orienting networks. The statistics indicate that the stress-exposed group demonstrated a faster response time than the non-stressed group, yet both groups maintained an equivalent degree of accuracy. They exhibit a swifter reaction time, presumably linked to increased alertness and vigilance.

Primary carers of children with neurodevelopmental problems exhibit a faster reaction time. The persistent pressures associated with caring for a child with a neurodevelopmental disability (NDD) exacerbate this elevated condition. The attention networks were examined, revealing no statistically significant differences between the two groups. Both groups exhibited a remarkable capacity to utilize alerting and orienting signals, leading to enhanced performance relative to environments devoid of

supplementary cues. The conflict resolution demonstrated throughout the implementation of congruent and incongruent trials revealed similarities between the two groups. No significant differences were identified between the stressed and non-stressed groups in the alerting, orienting, and executive control networks of attention. According to previous research [9], the concept posits that the three attention networks are separate entities that do not interact. The previously stated assertion is valid for the group not undergoing stress. The current analysis has yielded substantial data indicating a robust correlation between the attention networks in the stressed group. Within the group experiencing stress, a notable positive correlation was observed between the alerting and orienting networks. In contrast, a significant negative correlation was identified between the alerting and executive control networks.

The correlation between alertness and the primitive brain areas responsible for arousal indicates that frequent stimulation of these networks can significantly influence attention control and tactics in individuals under stress. Activating the alerting network facilitates the orienting network in swiftly concentrating on pertinent information. Conversely, it simultaneously inhibits the executive function's involvement in the attentional process, disrupting the top-down control mechanism. Future studies must prioritize integrating neuroimaging techniques to examine how these networks interact and influence each other in persons under chronic stress. This will enhance the comprehension of the long-term consequences of chronic stress exposure and the deficits linked to attentional brain networks.

5. Conclusion

This study examined the influence of caregiving-related stress on cognitive function, particularly attention networks, in mothers of children with cognitive impairments versus moms of normally developing children. The results suggested that the stressed group had markedly greater stress levels, as evidenced by increased scores on the Felt Stress Scale (PSS-10) and the Parental Stress Scale. This increased stress was associated with their caring duties, which entailed more demands and an intensified sense of obligation. The stressed group had accelerated reaction times in both congruent and incongruent tests, indicating an adaptive hyper-alertness potentially cultivated due to persistent caregiving obligations. Nonetheless, this enhanced speed did not compromise accuracy, as both groups demonstrated similar performance levels. These results underscore a complicated interaction between chronic stress and cognitive performance wherein increased stress may improve specific facets of attention, such as attentiveness while preserving accuracy.

Notwithstanding these adaptive responses, the enduring cognitive and emotional repercussions of chronic stress must not be disregarded. The heightened stress levels in care highlight the necessity for specific interventions to enhance their mental health and well-being. Mitigating chronic stress via psychological, social, and policy interventions is crucial for enhancing the quality of caregiving and the well-being of cares. This study underscores the substantial influence of caregiving-related stress on attention networks, highlighting the necessity to assist cares in their responsibilities and to alleviate the wider repercussions of chronic stress. Future studies should investigate the neurological underpinnings of these findings and assess therapies designed to alleviate care stress.

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