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Factors Affecting Cortisol Levels in Caregivers of Patients with Dementia

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Abstract

Background: Stress has adverse effects on the immune system, cardiovascular system, and neurosecretion. Regular or daily elevation of cortisol level has been shown to have physical and mental effects. However, few studies have examined factors that affect blood cortisol as an indicator of mixed physical and psychological stress in caregivers of dementia patients.
Purposes: This study aimed to identify health factors that affect cortisol levels in caregivers of dementia patients.
Methods: Caregivers living with dementia patients were included in this cross-sectional study. To analyze health factors affecting cortisol levels in caregivers of dementia patients, logistic regression analysis was performed with cortisol as the dependent variable, and caregiver age, sex, Zarit Caregiver Burden Interview (ZBI) score, BMI, and patient MMSE score as independent variables. This study was approved by the Bioethics Review Committee of Nagoya University.
Results: Cortisol level was significantly and negatively correlated with ZBI score (-0.306, $P<0.05$). ZBI score (OR 0.960: 95% IC 0.924-0.997) showed a significant association with cortisol level.
Discussion: Caregivers in this study may have adapted to the emotional, physical, and social burdens of their caregiving roles. Caregivers with chronic stress may not show excessive elevation of cortisol levels due to some factors.
Conclusion: Our results suggest that caregivers may have learned to cope with stress through their caregiving experiences. Future studies should investigate how caregivers can reduce the burden of caregiving and live with dementia patients with peace of mind.

Keywords: *ZBI; Caregiver burden; Dementia; Cortisol*

Introduction

The adrenal glands react to stress [1]. The adrenal cortex produces hormones such as cortisol as a short-term response stress. Chronic cortisol production, however, can lower the immune system function [2]. Since high levels of cortisol in the blood are associated with high levels of stress [3], cortisol has been used as a stress indicator. Chronic stress raises cortisol levels and negatively impacts health [4]. Extreme levels of stress have negative effects not only on the immune system, but also on the cardiovascular system and neurosecretion [5]. Daily increases in cortisol levels have been shown to have negative effects on physical and mental health.

Studies of caregivers have reported that cortisol production increases during caregiving [6]. One study reported that salivary cortisol levels in caregivers of dementia patients indicated higher stress levels compared to those in non-caregivers [7], and another study showed that caregiver hair samples contained elevated levels of cortisol [8]. However, few studies have examined factors that affect blood cortisol as an indicator of mixed physical and psychological stress caused by caregiving in caregivers of dementia patients.

The purpose of this study was to identify health factors that affect cortisol levels in caregivers of dementia patients.

Methods

Participants

Participants of this study were caregivers living with dementia patients. Caregivers with well-controlled chronic diseases (e.g., hypertension, diabetes, dyslipidemia) were included.

Study design

This study used a cross-sectional study design to analyze health factors affecting cortisol levels in caregivers of dementia patients.

Assessment of caregivers and care recipients

Cortisol is used as an endocrine indicator of stress response, as it is produced by the adrenal cortex and its secretion is regulated by the adrenocortical system [9]. Plasma cortisol levels show large diurnal variation. Since the highest level is observed in the early morning [10], blood samples were taken from our study participants in the morning with participants at rest.

The Japanese version of the Zarit Caregiver Burden Interview (ZBI) was used as an objective scale to evaluate caregiver burden [11]. Body mass index (BMI) [12] was used as an index of obesity. We used the MMSE [13], a screening test used worldwide, to evaluate dementia.

Statistical analysis

Logistic regression analysis was performed with cortisol as the dependent variable. Cortisol levels were defined as either high (1) or low (0), with the cutoff set at the median of 10.75 (1: ≥10.75, 0: <10.75). Independent variables included caregiver age, sex, ZBI score, BMI, and patient MMSE score. $P<0.05$ was considered statistically significant.

Ethical considerations

This study was approved by the Bioethics Review Committee of Nagoya University.

Results

Table 1 shows the characteristics of caregivers who participated in this study. Most of the participants had cortisol levels within the reference range. Median ZBI and MMSE scores were 28 (slightly moderate) and 19 (moderate), respectively.

Table 2 shows the results of the bivariate correlation matrix between hormone secretion and caregiver factors. Cortisol was significantly and negatively correlated with ZBI score (-0.306, $P<0.05$).

Table 3 shows the results of the binomial logistic stepwise regression analysis with cortisol as the dependent variable. Factors associated with cortisol were extracted as binary variables (0,1), divided into those below and above the median cortisol level. ZBI score (OR 0.960: 95% CI 0.924-0.997) was significantly associated with cortisol, whereas caregiver age, sex, BMI, and patient MMSE score were not.

Table 1: *Characteristics of study participants.*

	Median	IQR (25-75%)
Caregivers		
Age (years)	76	72-79
Cortisol (Reference value: 7.07-19.6 μg/dL)	10.8	8.9-13.3
ZBI	28	15-40.8
Dementia patients		
Age (years)	77	73-81.5
MMSE	19	15-23.3

ZBI: Zarit Caregiver Burden Interview score, MMSE: Mini Mental State Examination.

Table 2: *Correlation between cortisol and caregiver factors.*

		Sex	Age	ZBI
Cortisol	r	-0.185	0.098	-0.306*
	P	0.19	0.488	0.027

r: Spearman's correlation coefficient; P: P-value, †p＜0.1, *p＜0.05, **p＜0.01.

ZBI: Zarit Caregiver Burden Interview.

Discussion

In this study, ZBI score was identified as a health factor associated with cortisol in caregivers of dementia patients. Cortisol level was negatively correlated with ZBI score. When an organism is exposed to stress, hormone concentrations in saliva change in response to change in cortisol concentration in the blood [14]. A previous study reported that relative to non-caregivers, caregivers showed a greater increase in plasma cortisol concentration in response to stress [15]. Stress suggests that we may become accustomed to similar, repeated stressors [16]. Participants in the present study reported moderate caregiver burden, suggesting that caregivers may have increased tolerance to stress due to repeated exposure to chronic stressors. In a study that evaluated physiologic measures such as plasma adrenocorticotropic hormone levels, the severity of life stress and depression were not found to be associated with changes in multiple physiological functions [17]. Other studies reported that caregiver cortisol levels are higher during the waking hours, while smaller increases in cortisol levels were observed after waking compared to non-caregivers [18]. Interestingly, chronically stressed individuals did not differ from low-stress individuals in terms of increases in peak cortisol levels during the actual stressful event [19]. These findings suggest that caregivers with

chronic stress may not show excessive cortisol elevation due to some factors.

In the present study, ZBI score was a significant factor associated with cortisol. Generally, chronic stress increases cortisol secretion [20]. Caregivers may have less of an acute response to repeated stressors, as they are accustomed to stressful situations. Although no previous studies have reported on tolerance to stress in caregivers due to chronic stress exposure, studies of physical stress in sports found that tolerance to stress can lead to temporary decreases in cortisol before they return to baseline levels, suggesting that adaptive changes may occur [21]. Similarly, caregivers in this study may have adapted to emotional, physical, and social burdens of their caregiving roles.

Table 3: *Logistic regression analysis with cortisol as the dependent variable.*

						95% IC	
Dependent variable		Variable (Covariate)	B	*P*	OR	Upper limit	Lower limit
Cortisol		ZBI score	-.041	.035	.960	.924	.997
		Variables not in the equation	Score	P			
<10.75 = 0 ≥10.75 = 1	Variable 2	Age	.000	.987			
		Sex	.492	.483			
		BMI	1.520	.218			
		Patient MMSE	.251	.617			

B: Partial regression coefficient, P: Significance probability, OR: Odds ratio, 95% IC: 95% Confidence interval, BMI: Body mass index, ZBI: Zarit Caregiver Burden Interview, MMSE: Mini Mental State Examination.

Elevated cortisol levels can reportedly lead to the development of metabolic syndrome [22]. Cortisol levels were within the normal range in our participants, indicating that they may not have been overly stressed and may not have affected their BMI.

It is commonly observed that caregivers are under a lot of stress, and during times of high stress, cortisol secretion is increased. Therefore, caregivers need to find ways to alleviate stress. Daily exposure to stress has been found to be predictive of emotional responses to stress such as depression and anger, but enlisting caregiving help by way of adult daycare services or the equivalent may reduce some of these emotional responses [23]. Furthermore, social support has been suggested to mitigate the effects of caregiver stress and caregiving time on the cortisol arousal response [24]. Future studies should consider ways to reduce caregiving burden in caregivers so that they can live with dementia patients with better peace of mind.

Conclusion

The present study identified factors that affect cortisol levels in caregivers of dementia patients. A sense of caregiver burden was found to be associated with cortisol. Our results suggest that caregivers may have improved tolerance to stress, as they have developed caregiving methods and skills to cope with stress through their caregiving experiences. However, appropriate support will be necessary for caregivers who do not have sufficient experience in caregiving, as there is likely to be a cortisol response to caregiving stress.

Conflict of Interest Statement

None

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