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# The Effects of Coaching on Salivary Cortisol Stress Marker in Mothers with Young Children, A Randomized Controlled Trial

(乳幼児を養育する母親に対するコーチングがストレスマーカー、唾液コルチゾールに及ぼす効果:無作為化比較試験)

大橋純子

**Title:** The Effects of Coaching on Salivary Cortisol Stress Marker in Mothers with Young Children, A Randomized Controlled Trial

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## Abstract

**Objectives:** The purpose of this study was to evaluate the effects of a coaching program on saliva cortisol sensitivity in normal healthy mothers with young children.

**Methods:** A randomized controlled trial (RCT) was conducted with objective and subjective outcome measurements of the stress indicator. A postal survey to assess emotional intelligence (EI) was administered by random sampling to mothers of young children aged 3 months to 6 years in Japan. A total of 74 mothers with median EI scores or lower were enrolled in a RCT involving the coaching program. The intervention group received a 3-month coaching program. The control group was given the coaching program at follow-up. Stress state outcomes (saliva cortisol level, EI score, and Profile of Mood States (POMS)) were measured at baseline and immediate follow-up, with salivary cortisol measured again at a one-month follow-up.

**Results:** Significant differences were found for saliva cortisol level and the EI score within and between the intervention and control groups. Some POMS subscale scores were significantly different within the intervention and control groups.

**Conclusion:** The participants in the coaching program had significantly reduced saliva cortisol levels and better secondary outcomes than those in the control group.

**Key words:** coaching, saliva cortisol, parenting stress, randomized controlled trial

## **Introduction**

Parenting stress problems affect up to 50% of all mothers in Japan and are the commonest cause of severe infant abuse<sup>1)</sup>. Studies have reported that parenting stress is related with the well-being<sup>2)</sup> and quality of life<sup>3)</sup> of normal healthy mothers. Thus, reduction of parenting stress is essential for promoting the health and well-being of mothers and children.

Stress experiences in daily life need appropriate emotional treatment<sup>4)</sup>. High emotional intelligence (EI) promotes adaptive stress coping<sup>5)</sup> and leads to better mental health<sup>6)</sup>. In other words, EI is the ability to recognize your own emotions and feelings and those of others and to distinguish between them; this can help control thinking and behavior<sup>7)</sup>. Studies have shown that EI can be improved by coaching. A normative population study showed that parents given emotional coaching have children who do better academically and have less physical illness. The children are also better able to physiologically regulate their emotions<sup>8)</sup>. Coaching of highly emotional mothers was shown to lead to better peer relations in families with conduct-problem children<sup>9)</sup>. More recently, when the EI of mothers was raised via coaching, intimate partner violence (IPV) was shown to be unrelated to their children's behavior problems. On the other hand, in mothers with low EI, IPV was found to be associated with higher levels of aggression, depression, and anxiety<sup>10)</sup>. Another study found that coaching was effective for regulating the anger of mothers<sup>11)</sup>. Our previous work has also shown that higher EI in mothers with healthy children resulted in a reduction of parenting stress<sup>3)</sup>. From such findings, it seems clear that EI can be improved by coaching to enable stress coping, which can result in behavior promoting good health.

The development of the physiological response to stress is well established. This response, as indicated by levels of the neuroendocrine hormones cortisol and catecholamine,

is related to aspects of stress cognition<sup>12)</sup>. A significant correlation between serum cortisol and saliva cortisol has been reported<sup>13)</sup>. Thus, saliva cortisol can be used as a biological marker of stress for a noninvasive test. One study has shown cognitive-behavioral stress management interventions to be effective for reducing both salivary and serum cortisol levels in healthy adults without any medical complications<sup>14)</sup>. Other studies have suggested that higher job stress<sup>15)</sup> and higher working environment stress<sup>16)</sup> lead to increased levels of saliva cortisol.

The subjective assessment of stress may not be as useful as a biological response. Sabin<sup>17)</sup> found almost no relation between emotional changes and the physiological reaction caused by stress. However, there has been almost no report of biological indicators being used in studies on the effects of intervention on maternal stress assessment. In the present study, we focused on the sensitivity of using saliva cortisol as a measure of the effects of a coaching program. We hypothesized that our coaching program would improve the EI of mothers with young children, which, in turn, would lead to a reduction in saliva cortisol levels. We tested the effectiveness of such a coaching program for reducing levels of this biological stress indicator.

## **Theoretical Framework**

The transtheoretical model<sup>18)</sup>, social cognitive theory<sup>19)</sup>, and stress and coping theory<sup>20)</sup> were used to guide the development of our coaching program.

## **Methods**

### *Ethical considerations*

This study was conducted with the approval of the Ethics Committee of the Faculty of Medicine, Kyoto University (No. E1818). The study information was registered with the Japanese University hospital Medical Information Network (UMIN) center with guidance from the ethics committee of the World Health Organization (registration number: UMIN000013851. registration subject, development of coaching program to prevent infants abuse for mothers). Participants provided written and verbal informed consent.

### *Design*

This randomized controlled trial was designed to assess the effectiveness of a 3- month intervention consisting of a five-stage coaching program with a one-month follow-up. All eligible participants were assessed at baseline and received the intervention five-stage coaching program after 3 months. Only the cortisol level was assessed for the intervention group after the one-month follow-up. The primary outcome was the saliva cortisol level, and the secondary outcomes were the EI quotient and Profile of Mood States (POMS).

### *Study site and participants*

This study was conducted from June 2013 to March 2014 in Osaka, Japan. The inclusion criteria were mothers with young children aged 3 months to 6 years, an EI score at the median or lower, and consent to participate in the study. Based on our pilot study, the sample size was calculated to detect a 0.5 µg/dl difference in the area under the curve (AUC) between the intervention and control groups with respect to morning cortisol (AUC<sub>1</sub>) at a power of 0.80 and an alpha of 0.05. This required 17 mothers in each group. To account for dropouts, we aimed to recruit 25 mothers per group.

A postal survey was sent to the mothers of children aged 3 months to 6 years inclusive, based on random sampling from certificates of residence ( $n = 1,500$ ). The EI quotient and demographic information were obtained. A total of 1,012 questionnaires were returned (response rate 68%). The mean score on the EI scale for this population was 119, and the median value was 118. The median rather than the mean was used in this study because of the skewed distribution of the EI scores. A total of 463 mothers scored at the median or less. The mothers who consented to join the study ( $n = 74$ ; uptake = 16.0%) were assigned to a randomized controlled trial of the coaching program. The randomized group included 74 mothers between the ages of 20 and 30 years ( $M = 35.5$ ,  $SD = 5.1$ ), all of whom were housewives, had at least 12 years of education, were living in an average economic situation, and were living in Japan. The exclusion criteria of this study were persons with mental illness or who were pregnant. The intervention group consisted of 38 mothers, and the control group consisted of 36 mothers. We ran the trial in accordance with the CONSORT statement (Figure 1).

### *Randomization procedure*

Each participant was identified by code without a personal name. Mothers were allocated to the coaching intervention group and the control group on the basis of randomization with equal allocation. The control group participated in a coaching program post intervention. The allocation schedule was generated with computer by an assistant not involved in the study.

### *Intervention*

The coaching was done by a qualified public health nurse. The participants received group coaching. The program's sessions were held at a local community center from 9:30 am to 11:30 am. The intervention comprised five sessions over three months from November 2013 to January 2014. One session lasted 120 minutes and were held once every two weeks. To enable the mothers to concentrate on the program, they could leave their children with childcare workers at a local community center while they received coaching. The participants were coached to take responsibility for higher EI and reduction of stress.

### *Five-stage coaching program*

The program was aimed at improving stress cognition by mothers and enhancing self-management. The five-stage coaching program is presented in Figure 2.

### *Outcomes*

The outcome measures were obtained with a questionnaire and the saliva cortisol level. The questionnaire consisted of three parts: demographic information, clinical questionnaire, and the Japanese versions of the EI and POMS.

A demographic and clinical questionnaire was used to collect information on the ages of the mother and child, education level, employment status, economic status, and diagnosis of expectant mothers.

The EI quotient scale<sup>21)</sup> is a self-report measure of emotionally and socially intelligent behavior, that provides an estimate of a person's underlying emotional and social intelligence. The EI scale comprises 65 items divided into three subscales of intrapersonal factors, interpersonal factors, and situation management factors. The internal consistency reliability

values (Cronbach's coefficient of  $\alpha$ ) of the three subscales are 0.894, 0.915, and 0.915<sup>21</sup>). Each item is rated on a 5-point Likert scale ranging from 0 (*not at all*) to 4 (*extremely*). Scores for the three subscales and the total score were calculated according to published scoring algorithms<sup>21</sup>). The total EI score ranges from 0 to 252. The higher the total score, the better is the mental health as measured by the General Health Questionnaire<sup>21</sup>).

The Japanese version of the POMS is a self-report measure, designed to evaluate mood status. The POMS consists of six mood subscales: tension-anxiety, depression-dejection, anger-hostility, vigor, fatigue, and confusion. The POMS has 30 items, each rated on a 5-point Likert scale ranging from 0 (*not at all*) to 4 (*extremely*). The score of the six mood subscales is calculated according to published scoring algorithms<sup>22</sup>). The total score of the POMS ranges from 0 to 20. A low POMS score indicates a better mood state, except for the vigor subscale. The validity and reliability of the Japanese version have been confirmed<sup>22</sup>).

A well-established salivary collection protocol that included using consistent collection materials and methods was carefully followed<sup>23</sup>). Saliva samples were collected by using cotton swabs in Salivette devices (Salimetrics, State College, PA, USA). Participants were instructed to refrigerate the sample tubes after collection. The samples were collected by an assistant who submitted them to the laboratory. The sample tubes were immediately centrifuged at  $1,500 \times g$  for 15 min to collect the saliva from the swab. Saliva samples were stored at  $-80^{\circ}\text{C}$  until analysis. All samples were assayed for salivary cortisol using a highly sensitive enzyme immunoassay kit (Salimetrics, State College, PA, USA). This assay was designed to capture the full range of the salivary cortisol level (0.003 to 3.0  $\mu\text{g}/\text{dl}$ ) using only 25  $\mu\text{l}$  of saliva per test. All samples were assayed in duplicate. The criterion for repeat testing was variation of more than 20% between duplicates. The average of the duplicates was used in all analyses.

### *Data collection*

Data were collected by assistants at baseline, immediate follow-up, and one-month follow-up (cortisol). To standardize the saliva collection method from the baseline measurement, the participants were asked to attend a meeting at which we distributed explanations, cotton swabs, saliva tubes, and questionnaires. On the appointed day, completed questionnaires and saliva samples were collected by an assistant, who then conducted the randomization. In the follow-up, questionnaires and saliva samples were again collected by an assistant.

### *Statistical analysis*

The data were analyzed using SPSS version 18. The statistical significance of changes in score from baseline to immediate follow-up and one-month follow-up within each group was calculated using the paired t-test for the outcome measures. For baseline data, demographic variables were analyzed using two-sample t-tests,  $\chi^2$ -tests, or Mann-Whitney tests for comparisons between groups. Mean score changes in the control and intervention groups were analyzed using two-sample t-tests. To accurately analyze the saliva cortisol level, data for periods during menstruation or lack of sleep were excluded. Mothers collected four saliva samples per day (08:00, 12:00, 16:00, 20:00) to be used for calculation of the area under the curve during the morning ( $AUC_1$ ), afternoon ( $AUC_2$ ), night ( $AUC_3$ ), and day ( $AUC_G$ ). The AUC can be used to compare changes in the cortisol secretion quantity and is a reliable test<sup>23</sup>. The AUCs were calculated as follows<sup>24</sup>:  $AUC_1 = (a + b)/2 \times (12 - 8)$ ,  $AUC_2 = (b + c)/2 \times (16 - 12)$ ,  $AUC_3 = (c + d)/2 \times (20 - 16)$ , and  $AUC_G = AUC_1 + AUC_2 + AUC_3$ , where a = cortisol

level at 08:00, b = cortisol level at 12:00, c = cortisol level at 16:00, and d = cortisol level at 20:00. A p-value of  $< 0.05$  was considered statistically significant.

## Results

### *Participants*

Of the remaining 74 participants, eight did not complete the study because they were not available, during the scheduled period due to the illness of their child or did not wish to participate further. The overall retention rates for the intervention and control groups were 86.8% and 91.7%, respectively. The attendance rate for the intervention sessions was high, with 91.7% of the intervention group attending all sessions. Four mothers in the intervention group and six in the control group were excluded from analysis for not meeting the inclusion criteria for cortisol level due to menstruation or lack of sleep (Figure 1). Of the 29 participants in the intervention group, 27 returned saliva samples at the one-month follow-up. Information on the demographic and baseline characteristics of the intervention and control groups is presented in Table 1. The groups were broadly similar at baseline, suggesting a high level of homogeneity of variance between these two groups. The mean EI scores of the initial 463 mothers was 92.1; the mean value of the 74 mothers in the intervention and control groups was 98.2.

### *Changes between baseline and follow-up scores*

*Saliva cortisol:* At baseline, there were no significant differences in the saliva cortisol level between the two groups (Table 1). The cortisol level showed a circadian rhythm (Figure 3). The intervention group's scores for  $AUC_1$ ,  $AUC_2$ ,  $AUC_3$ , and  $AUC_G$  were significantly ( $P$

<0.05) lower than those at baseline at both immediate follow-up and one-month follow-up (Table 2). The AUC<sub>1</sub> of the intervention group fell more than the AUC<sub>2</sub> and AUC<sub>3</sub>. The control group did not show a significant reduction in the AUC<sub>1</sub>, AUC<sub>2</sub>, AUC<sub>3</sub>, and AUC<sub>G</sub> at immediate follow-up. The control group, however, showed a significant increase in the AUC<sub>1</sub> and AUC<sub>G</sub> at immediate follow-up ( $P < 0.05$ ; Table 2).

*EI:* At baseline, no significant differences were found in the EI total scores and the three subscales between the two groups (Table 1). The intervention group's EI total scores were significantly ( $P < 0.05$ ) higher than those at baseline at immediate follow-up. This reflected significant ( $P < 0.05$ ) increases in all the subscales at immediate follow-up. The control group showed a reduction in the scores (Table 2).

*POMS:* At baseline, there were no significant differences in the POMS subscales between the two groups (Table 1). The intervention group showed significant ( $P < 0.05$ ) improvement. The changes in the tension-anxiety, depression-dejection, vigor, and fatigue subscales were significant at the immediate stage in the intervention group, but they were not for the anger-hostility and confusion subscales (Table 2). The control group did not show a significant difference at immediate follow-up, except for a significant ( $P < 0.05$ ) reduction in the vigor subscale (Table 2).

#### *Differences between the intervention and control groups*

The primary aim of the trial was to detect a significant ( $P < 0.05$ ) difference between the control and intervention groups in salivary cortisol levels (AUC<sub>1</sub>, AUC<sub>2</sub>, AUC<sub>3</sub>, and AUC<sub>G</sub>). Differences between the groups are shown in Table 3: AUC<sub>1</sub>= -0.50  $\mu\text{g/dl}$  (95% CI: -0.80 to -0.20), AUC<sub>2</sub>= -0.27  $\mu\text{g/dl}$  (95% CI: 0.44 to -0.11), AUC<sub>3</sub>= 0.16  $\mu\text{g/dl}$  (95% CI: -0.25 to -0.07), and AUC<sub>G</sub>= -0.95  $\mu\text{g/dl}$  (95% CI: -1.43 to -0.48). The annualized effect size is

shown in Table 3. Analyses of secondary outcomes revealed a significant ( $P<0.05$ ) improvement in the intervention group compared with the control group in the EI total score and the three subscales. The POMS subscales showed no significant improvement in this program.

## **Discussion**

Our initial survey had a good response rate of 68%. While all social groups were well represented in the trial, the sample from which the study was drawn was not entirely representative. Full-time homemaker mothers were overrepresented. The mothers who consented to participate in the trial were representative of eligible mothers from a socioeconomic point of view and were also more likely to have higher EI scores than those who refused. This study was conducted in a single city located in the southern suburb of Osaka. However, the family structure of the majority of subjects represented that of the child-rearing generation (i.e., husband and wife with children). Furthermore, it was characteristic in that the city focused on maternal and child health measures. This single study cannot offer sufficient evidence about what would happen if such a program was offered in other geographic regions. Also, the overrepresentation of full-time homemakers detracts from generalization of the results. However, the facts that mothers from all social groups attended the program and that the program attracted mothers with parenting stress should be viewed as encouraging.

Allocation to groups was done by randomization with equal allocation. This method is more powerful than any other type of randomization<sup>25</sup>). In this study, the sample size was

relatively large to enable detection of differences in the cortisol levels between subgroups in the control and intervention groups.

#### *Effect of coaching on salivary cortisol*

The cortisol level we observed showed a circadian rhythm<sup>23)</sup>. The effect size between groups for mean cortisol AUC<sub>G</sub> was significantly greater (0.95 µg/dl). The effect size corresponded with high parenting stress<sup>26)</sup>. The change between baseline and follow-up in the intervention group for the cortisol area under the curve in the morning (AUC<sub>1</sub>) was reduced by more than those in the afternoon (AUC<sub>2</sub>) and night (AUC<sub>3</sub>). AUC<sub>1</sub> reflects both chronic stress and acute stress caused by expected events<sup>27)</sup>. Furthermore, some degree of parenting stress is caused by the individual's negative perceptions of parenting and stressors<sup>28)</sup>. Another study showed that cognitive-behavioral stress management interventions can be effective for reducing salivary cortisol levels in healthy adults without any medical complications<sup>15)</sup>. The coaching program developed for this study focused on improving stress cognition in mothers. Therefore, our results provide evidence that the coaching program changed stress cognition. The program is also a behavior management program<sup>18)</sup> and it helped to maintain decreased cortisol levels at one month after the intervention. Our results suggest that this coaching program is effective in reducing cortisol stress markers in mothers.

#### *Effect of coaching on subjective stress indicators*

The intervention group showed a significant increase in total EI score, and the three subscales scores (intrapersonal factors, interpersonal factors, and situation management factors) of the intervention group increased more than those of the control group at immediate follow-up. Intrapersonal factors, interpersonal factors, and development of situation EI are

related to frontal lobe development<sup>29)</sup>. Research has also suggested that myelination of the frontal lobe can continue to occur after adolescence<sup>30)</sup>. In our study, the mean age of the participants was 35 years. Thus, our findings suggest that even after adolescence, coaching can improve EI<sup>8,10,11)</sup>. These observations lend support to the efficacy of our program for improving the EI of mothers by intervention. The intervention group scores for the tension-anxiety, depression-dejection, vigor, and fatigue subscales of the POMS were improved at immediately after the program. However, between the two groups, no significant differences were observed for the six subscales. As this study sample size was calculated to detect differences in cortisol level, the POMS trial was not powered to detect a difference between groups.

## **Conclusions**

The results from this study offer evidence for the effectiveness of a program for reducing stress in mothers with young children. The attendance rate for the intervention sessions was high. These results lend support to the feasibility of a population approach to the promotion of mental health through coaching programs.

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The authors have no potential conflicts of interest to disclose.

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**Table 1. Baseline characteristics by group**

	Intervention (n=29)	Control (n=27)	P-value
	n (%)	n (%)	
Occupation <sup>1</sup>			
Housewife	19 (65.5%)	17 (63.0%)	.886
Full-time worker	6(20.7%)	5 (18.5%)	
Part-time worker	4 (13.8%)	5 (18.5%)	
Single parent	1 (3.4%)	1 (3.7%)	.736
	Mean (SD)	Mean (SD)	
Mother's age (years)	34.81±5.07	34.92±5.16	.678
Economic situation <sup>2</sup>	2.21±0.82	2.33±0.62	.550
Education <sup>3</sup>	3.90±1.11	3.59±1.21	.340
Child age (months)	20.66±18.17	21.96±16.65	.780
Salivary cortisol			
AUC <sub>1</sub>	1.28±0.63	1.05±0.47	.117
AUC <sub>2</sub>	0.57±0.36	0.50±0.17	.353
AUC <sub>3</sub>	0.31±0.21	0.30±0.14	.864
AUC <sub>G</sub>	2.16±1.03	1.84±0.59	.166
Emotional Intelligence (EI)			
Total score	98.72±17.38	97.59 ±18.23	.810
Intrapersonal factors	33.69±6.90	34.04±6.40	.846
Interpersonal factors	37.07±7.80	34.96±8.5	.338
Situation management factors	27.97±7.98	28.59±9.45	.789
Profile of Mood States (POMS)			
Tension-anxiety	5.31±3.98	5.00±3.72	.765
Depression-dejection	3.17±3.24	3.15±3.42	.978
Anger-hostility	5.52±3.04	5.52±3.41	.999
Vigor	6.34±3.22	7.22±2.95	.294
Fatigue	5.93±4.42	5.63±4.57	.803
Confusion	6.31±3.06	5.89±2.59	.582

Comparison between groups was performed with two-sample t-tests. Occupation and Single parent were compared with  $\chi^2$ -tests. Economic situation and Education were compared with the Mann-Whitney test.

AUC<sub>1</sub>, AUC<sub>2</sub>, AUC<sub>3</sub>, and AUC<sub>G</sub>: area under the curve in the morning, afternoon, night, and day respectively. <sup>1</sup>Occupational status: housewife/work leave=0, full- and part-time worker=1. <sup>2</sup>Economic situation (1 to 4): unfavorable(1) to favorable(4). <sup>3</sup>Educational background: junior high school=1, senior high school=2, vocational school/college=3, university/graduate school=4.

**Table 2. Changes between baseline and follow-up scores in the intervention and control groups**

	Intervention			Control	
	Baseline (n=29)	Immediate follow-up (n=29)	1-month follow-up (n=27)	Baseline (n=27)	Immediate follow-up (n=27)
	Mean (SD)	Mean (SD)	Mean (SD) <sup>a</sup>	Mean (SD)	Mean (SD)
Salivary cortisol					
AUC <sub>1</sub>	1.28 (0.63)	0.84 (0.49) <sup>***</sup>	0.92 (0.39) <sup>***</sup>	1.05 (0.47)	1.34 (0.63) <sup>*</sup>
AUC <sub>2</sub>	0.57 (0.36)	0.35 (0.15) <sup>**</sup>	0.38 (0.15) <sup>*</sup>	0.50 (0.17)	0.63 (0.41)
AUC <sub>3</sub>	0.31 (0.21)	0.21 (0.09) <sup>*</sup>	0.20 (0.10) <sup>*</sup>	0.30 (0.14)	0.36 (0.23)
AUC <sub>G</sub>	2.16 (1.03)	1.40 (0.03) <sup>***</sup>	1.45 (0.54) <sup>**</sup>	1.84 (0.59)	2.35 (1.07) <sup>*</sup>
Emotional Intelligence (EI)					
Total score	98.72 (17.38)	113.48 (26.25) <sup>**</sup>		97.59 (18.23)	93.48 (16.27)
Intrapersonal factors	33.69 (6.90)	38.59 (10.61) <sup>*</sup>		34.04 (6.40)	32.44 (8.55)
Interpersonal factors	37.07 (7.80)	41.76 (9.44) <sup>***</sup>		34.96 (8.5)	34.67 (6.98)
Situation management factors	27.97 (7.98)	32.72 (9.65) <sup>***</sup>		28.59 (9.45)	26.37 (8.45)
Profile of Mood States (POMS)					
Tension-anxiety	5.31 (3.98)	3.93 (3.05) <sup>*</sup>		5.00 (3.72)	5.52 (3.76)
Depression-dejection	3.17 (3.24)	2.10 (2.45) <sup>*</sup>		3.15 (3.42)	2.44 (2.53)
Anger-hostility	5.52 (3.04)	4.59 (3.17)		5.52 (3.41)	5.89 (4.12)
Vigor	6.34 (3.22)	7.52 (3.57) <sup>*</sup>		7.22 (2.95)	6.56 (3.12) <sup>*</sup>
Fatigue	5.93 (4.42)	4.48 (4.35) <sup>*</sup>		5.63 (4.57)	5.59 (5.03)
Confusion	6.31 (3.06)	5.93 (3.36)		5.89 (2.59)	6.19 (3.21)

Changes between baseline and follow-up scores in each group were calculated using the paired t-test.

AUC<sub>1</sub>, AUC<sub>2</sub>, AUC<sub>3</sub>, and AUC<sub>G</sub>: area under the curve in the morning, afternoon, night, and day, respectively. <sup>a</sup> 1-month follow-up was only performed for the salivary cortisol levels in the intervention group.

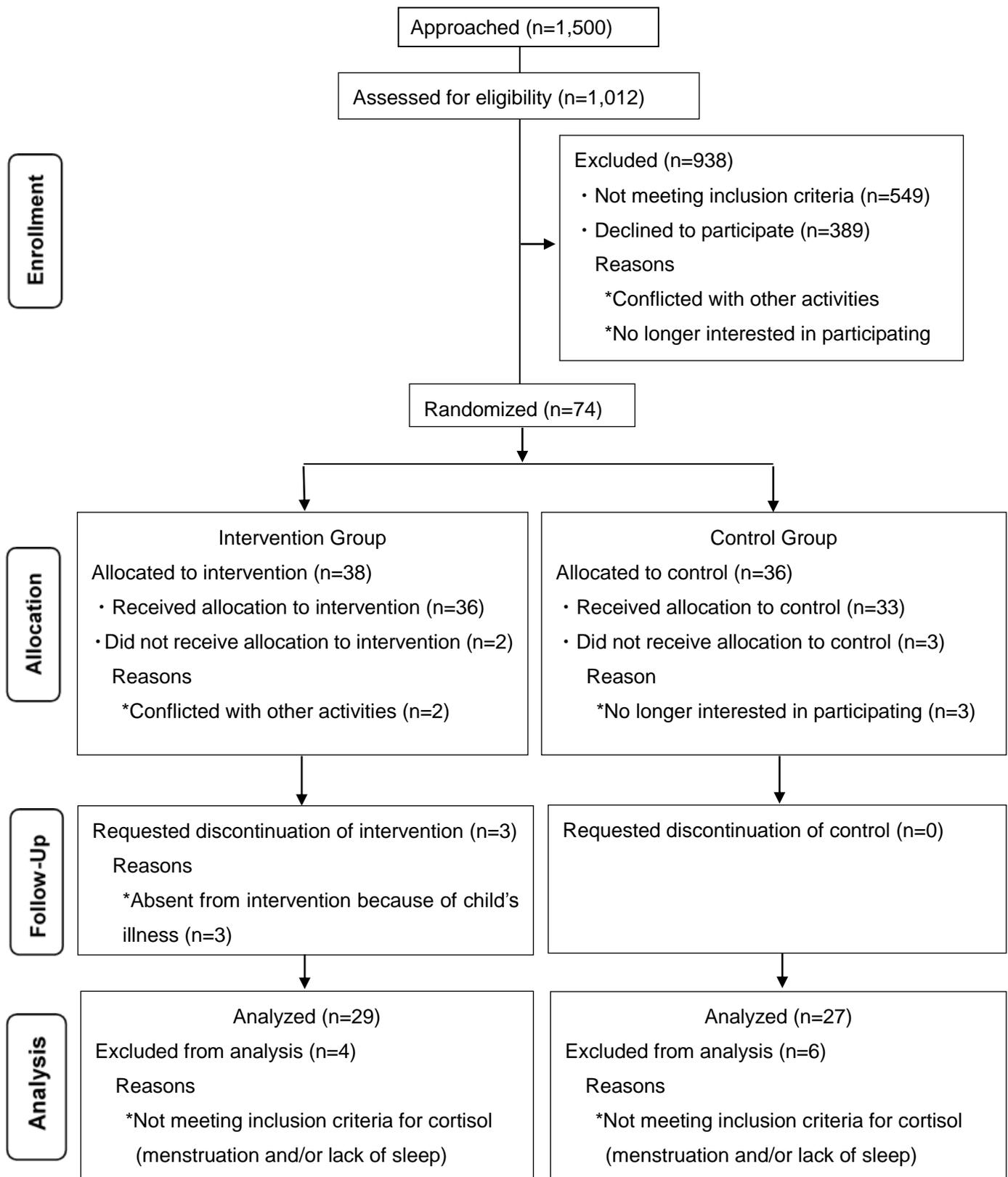
\* $P < .05$ ; \*\* $P < .01$ ; \*\*\* $P < .001$ .

**Table 3. Comparison of randomized groups at immediate follow-up**

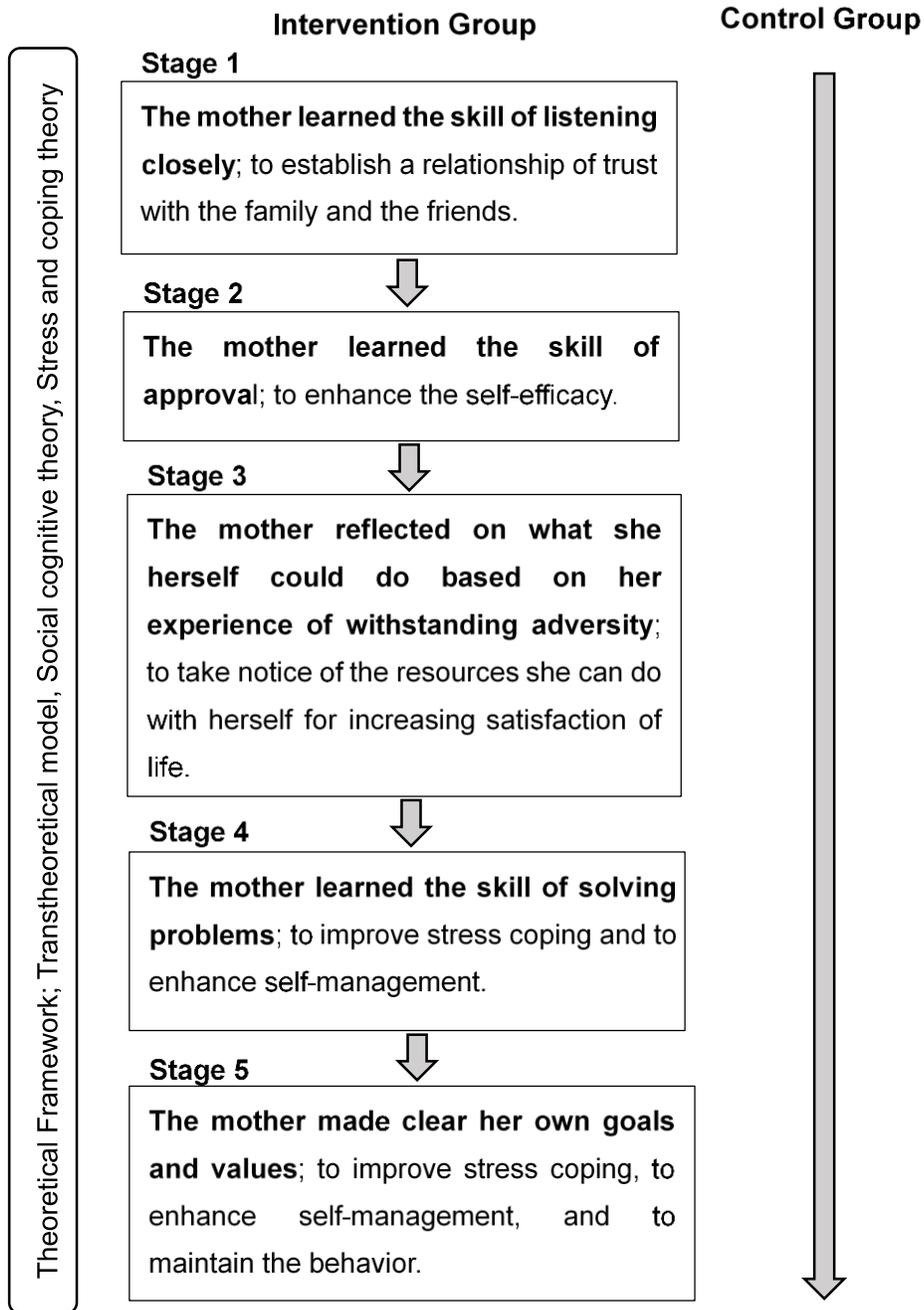
	Immediate follow-up			Effect size	Annualized effect size (Cohen's <i>d</i> )
	Intervention (n=29)	Control (n=27)	<i>P</i> -value		
	Mean (SD)	Mean (SD)		Mean (95% CI)	(95% CI)
Salivary cortisol					
AUC <sub>1</sub>	0.84 (0.49)	1.34 (0.63)	.002	-0.50 [-0.80, -0.20]	0.89 [0.09, 1.44]
AUC <sub>2</sub>	0.35 (0.15)	0.63 (0.41)	.002	-0.27 [0.44, -0.11]	0.91 [0.09, 1.46]
AUC <sub>3</sub>	0.21 (0.09)	0.36 (0.23)	.002	-0.16 [-0.25, -0.07]	0.94 [0.09, 1.49]
AUC <sub>G</sub>	1.40 (0.67)	2.35(1.07)	<.001	-0.95 [-1.43, -0.48]	1.07 [0.08, 1.63]
Emotional intelligence (EI)					
Total score	113.07 (24.85)	93.48 (16.27)	.001	19.59 [8.24, 30.93]	0.93 [0.09, 1.48]
Intrapersonal factors	38.59 (10.61)	32.44 (8.55)	.021	6.14 [0.96, 11.33]	0.64 [0.10, 1.18]
Interpersonal factors	41.76 (9.44)	34.67 (6.98)	.002	7.09 [2.62, 11.57]	0.85 [0.09, 1.40]
Situation management factors	32.72 (9.65)	26.37 (8.45)	.012	6.35 [1.48, 11.23]	0.70 [0.10, 1.24]
Profile of Mood States (POMS)					
Tension-anxiety	3.93 (3.05)	5.52 (3.76)	.09	-1.59 [-3.44, 0.24]	0.47 [0.11, 1.00]
Depression-dejection	2.10 (2.45)	2.44 (2.53)	.61	-0.34 [-1.78, 1.00]	0.14 [0.12, 0.67]
Anger-hostility	4.59 (3.17)	5.89 (4.12)	.19	-1.30 [-3.26, 0.66]	0.36 [0.11, 0.89]
Vigor	7.52 (3.57)	6.56 (3.12)	.29	0.96 [-0.84, 2.76]	0.29 [0.11, 0.82]
Fatigue	4.48 (4.35)	5.59 (5.03)	.38	-1.11 [-3.62, 1.40]	0.24 [0.11, 0.77]
Confusion	5.93 (3.36)	6.19 (3.21)	.77	-0.25 [-2.02, 1.51]	0.06 [0.12, 0.58]

Comparison between groups was performed with two-sample t-tests.

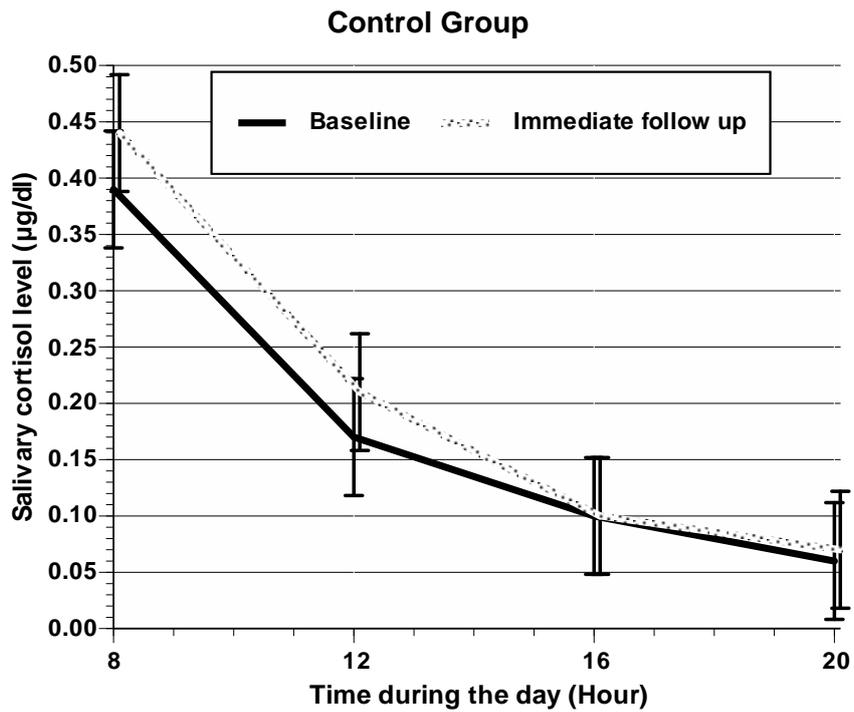
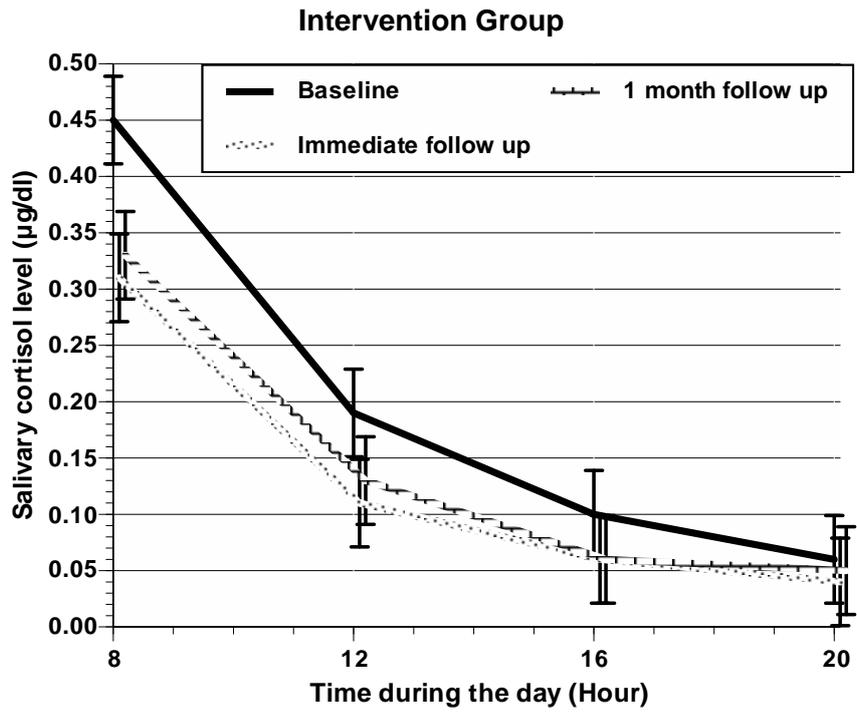
AUC<sub>1</sub>, AUC<sub>2</sub>, AUC<sub>3</sub>, and AUC<sub>G</sub>: area under the curve in the morning, afternoon, night, and day, respectively.



**Figure 1.** Consolidated standards of reporting trial (CONSORT) flowchart participants through randomized controlled trial.



**Figure 2.** The coaching program; a five-stage process. Transtheoretical model, social cognitive theory, and stress and coping theory were used to guide the development of the coaching program. The five-stage process is indicated for the intervention group. The shaded arrow indicates ordinary life.



**Figure 3.** Mean salivary cortisol level for 4 time points per day and for each measurement.