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The effect of aromatherapy upon salivary cortisol, academic stress, academic self-efficacy and suicidal ideation in middle school students.

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Abstract

This study was attempted in order to offer basic data, which are useful for understanding and guiding middle school students' behavior in the school field, to teachers and counselors by closely examining which influence the application of aromatherapy intervention targeting middle school students has upon academic stress, academic self-efficacy, suicidal ideation, and salivary cortisol. As this is a study in the randomized control group pre-post test design that applied with making aroma essential oil in the form of aroma stick so that continuous management can be easy, it proved the effective intervention method available for being used in alleviating academic stress and enhancing academic self-efficacy in middle school students by objectively verifying an effect of aroma essential oil. Also, a useful method was suggested that even the middle school students as the stressful youths can easily use with having an interest in own health promotion. The intervention of aromatherapy using aroma essential oil has significance in corresponding to a flow of stress and health management in modern times of pointing to a natural healing method focusing on a concept of wellbeing, and in offering a scientific basic of a complementary and alternative therapy.

Keywords: Aromatherapy, Salivary cortisol, Academic stress, Academic self-efficacy, Suicidal ideation.

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Introduction

As adolescence is the period of getting into a lot of worries, conflicts and confusions while repeating the physically and emotionally rapid change & growth due to a characteristic of the transitional development stage of growing into adulthood, it is experiencing high achievement pressure and more stress amidst the conflict and tension in the era of limitless competition [1]. Our country's adolescents, who are spending most of the time on what is related to studying such as a school or a private educational institute, were indicated to have the stress related to schoolwork the most [2]. A problem relevant to learning can be tried to be actually divided a type. The problems can be taken such as a worry & stress caused by low school performance, the test anxiety, a drop in academic efficiency, skepticism over studying, and poor motivation. Adolescents' this excessive academic stress according to academic problem not only causes emotional matter and abnormal behavior, but also leads to drastic action in case of failing to overcome through an appropriate response [3]. Given seeing a research related to the influence of academic stress upon adolescents, it is being reported that the youths' coming to suffer emotional pain caused by stress arouses the adaptative problems like depression, self-distrust, complex, criminal act, and low school performance [4]. A preventive effort such as nurturing a coping ability so that adolescents can be well adapted to the imminent stress, or as giving a proper help through finding youths who have possibility of likely showing a problem is said to be just the most effective countermeasure against a youth issue that is emerging as a serious social issue [5]. For adolescents to proceed with being well adjusted to school life in the right direction, a management method is needed that is available for understanding own stress caused by schoolwork and for handling properly and preventing this. The process is demanded that can manage own stress efficiently with minimizing maladjustment behavior and academic stress through this. As the academic self-efficacy is a judgment and belief on own ability as saying of being capable of successfully performing and solving a schoolwork and a learning task, it is known as what influences the learning performance and achievement level. Low academic self-efficacy appears as low academic achievement and comes to be indicated as maladjustment to school life owing to the negative evaluation by parents or teachers, to the self-depreciation of being shown by failing to satisfy own demand, to a worry related to future responsibility, and to practical distortion [6]. As a result of comparing a stress case that middle school students receive in daily life, they were indicated to get stressed in order of a problem about a school record, a problem relevant to a friend of the opposite sex, and a problem about character and

psychology [7]. Oh and Chen [8] mentioned that it is indicated to be in order of examination, school record, school environment, learning, class, career, relationship with a teacher, family relation, the surrounding environment, friendship, and family environment in consequence of minutely surveying and classifying a cause for academic stress targeting middle school students. In light of the above findings, a cause for stress that students get has a little difference depending on gender and age, but can be known that an academic problem like learning or school record is the most principal cause. Adolescents' suicidal ideation was ever clarified to have a close relationship with stress [9,10]. As the suicidal ideation is a thought of desiring to kill oneself, it implies to be grown a suicidal risk that makes a plan of implementing a desire as a scheme [11]. The suicidal ideation is not what is certainly led to the suicidal attempt, but may be an important predictor of the suicidal attempt afterward, thereby being very crucial to be explored prior to suicidal ideation or suicidal attempt. Hence, the suicidal ideation can be a predictive factor of suicide. An exploration of the suicidal ideation and the suicidal plan may be an important stage available for deciding on suicide [12]. A suicidal act takes place when experiencing a case of stress and hard life [13]. In a research that analyzed a relationship among academic stress, depression and suicidal ideation, it was reported that the more experience of stress leads to the more rise in depression and that depression leads to a growth in suicidal ideation [14].

Aroma essential oils effective for coping with stress include the Roman Chamomile essential oil and Lavender essential oil, which induce a lessening of tension, lower nervousness, and alleviate headaches, the Rosemary essential oil, which is helpful for a fatigue reduction, and the rose oil, which gets over depression, guilt complex, melancholy, and impotent feeling [15]. The ingredients of α-pinene and camphene in Roman Chamomile essential oil relieve depression, anxiety and stress. The ingredients of α-pinene, limonene in Lavender essential oil inhibit a function of sympathetic and parasympathetic nerve and eases symptoms like nervous tension or restlessness, and rigidity [15]. The complete guide to aromatherapy (2nd Ed). Brisbane, International Centre of Holistic Aromatherapy [15,16]. The ingredients of α-pinene and β-pinene in rose essential oil are useful for heart acceleration, agitation, and insomnia as neuro-depressant [17]. The ingredient of α-pinene in Rosemary essential oil stimulates the central nervous system, thereby improving concentration and alleviating a nervous breakdown [18]. Aroma essential oil is mostly excreted in urine with being metabolized in the liver without being accumulated in the body compared to chemicals [19], thereby being able to be applied relatively and safely even to a patient with a drop in physical function [20]. It is being recently attempted a scientific proof as a complementary and alternative therapy available for maintaining and promoting physical, mental and psychological health by which the use of therapeutic aroma essential oil ingredients leads to controlling the autonomic nervous system and the endocrine system [21].

Accordingly, this study was attempted in order to offer basic data, which are useful for understanding and guiding middle school students' behavior in the school field, to teachers and counselors by closely examining which influence the application of aromatherapy intervention targeting middle school students has upon academic stress, academic self-efficacy, suicidal ideation, and salivary cortisol.

Research hypotheses

The hypotheses of this study are as follows:

1. There will be a difference in academic stress between the experimental group with the application of aromatherapy and the control group.
2. There will be a difference in academic self-efficacy between the experimental group with the application of aromatherapy and the control group.
3. There will be a difference in suicidal ideation between the experimental group with the application of aromatherapy and the control group.
4. There will be a difference in salivary cortisol between the experimental group with the application of aromatherapy and the control group.

Research Method

Research design

This study applied the randomized control group pre-post test design in order to grasp the effects of using aromatherapy in middle school students on academic stress, academic self-efficacy, suicidal ideation, and salivary cortisol.

Research subjects

The subjects of this study are set to be middle school students in W city of Gangwon-do Province who were described and then agreed to the plan of this study. Number of research subjects was calculated by using G-power 3.1.6 version. 44 people were demanded when being set to be 2 as number of group, 3 times as frequency of measurement, 0.25 as moderate effect size, 0.05 as significance level, and 0.95 as statistical power for the repeated measures ANOVA. As a result of collecting subjects necessary for the research through referring to this, 49 people were raised. The selection of experimental group and control group was assigned to experimental group and control group after giving number in order of the application for participation and randomizing with excel. During the period of experimental treatment, the experimental group was eliminated 4 people. The control group was dropped 3 people during the period of experimental treatment. The finally research subjects included 20 people for the experimental group and 22 people for the control group.

Research tools

Measurement tool of academic stress: This study used the test of academic stress that Oh and Chen [8] developed in order

to gauge academic stress in middle school students. It is composed of 75 questions related to a cause for academic stress. 11 sub-factors according to a cause for academic stress comprised sub-scales such as school record, exam, class, learning, career, relationship with a teacher, relationship with a friend, school environment, home environment, and the surrounding environment. Each item is based on 5-point scale with “not so at all (1 point),” “tend not to be so (2 points),” “usually so (3 points),” “mostly so (4 points),” “so yes (5 points)”. It implies that the higher score leads to the higher academic stress level. The reliability in this study stood at Cronbach's alpha=0.94.

Measurement tool of academic self-efficacy: The scale of academic self-efficacy, which was developed and standardized by Kim and Park [22], was used. This scale consists of 3 spheres in self-confidence, self-regulated efficacy, and a preference for task difficulty. Each question is composed of 6-point scale in “not so at all (1 point),” “not quite so (2 points),” “tend not to be so (3 points),” “tend to be so (4 points),” “tend to be quite so (5 points),” “so yes (6 points).” It implies that the higher score leads to the higher academic self-efficacy. The reliability in this study came to Cronbach's alpha=0.80.

Measurement tool of suicidal ideation: A tool of measuring suicidal ideation was used the tool with 19 questions that Shin et al. [23] changed the measurement tool of suicidal ideation developed by Beck et al. [19] into the self-reported questionnaire. It implies that the higher score leads to the higher suicidal ideation level based on 3-point scale. The reliability in this study reached Cronbach's alpha=0.86.

Salivary cortisol: A method of sampling saliva was collected saliva in a plastic sputum bottle in the wake of not swallowing after 10 minutes of rinsing the mouth with cold water between 3 to 4 O'clock in the afternoon. The collected saliva sample was immediately put in a refrigerator and then was kept until before being tested. For the test, it was put in ice box for transportation and then was analyzed with being entrusted to Inspection Agency. Salivary cortisol was analyzed by using Spectra Max 190 Reader (USA) reagent (Salivary Cortisol ELISA, Germany) as Enzyme Immunoassay (ng/ml).

Procedure of data collection

The data collection of this study was carried out for 4 weeks from November 2016 to December. The deliberation of the Bioethics Committee was passed prior to the experiment. The pre-post test gauged academic stress, academic self-efficacy, suicidal ideation, and salivary cortisol level.

Experimental treatment

It passed the approval on the deliberation of the Bioethics Committee. It obtained consent for participation from the research subjects and notified that they can withdraw the participation anytime in case of not agreeing to the research in the middle of the research. It explained side effect that is created by aroma essential oil in the way of the experimental treatment.

Statistical analysis

The collected data were analyzed by using SPSS 21.0 program. The general characteristics and the result variables were analyzed by using error, percentage, the mean and the standard deviation. A homogeneous test between research groups was analyzed by using Chi square test, t-test, Fisher's exact test. Verification of a difference between the experimental group and the control group was analyzed by using independent t-test.

Results

Verification of homogeneity between research groups

Verification of homogeneity on general characteristics: As a result of inspecting homogeneity on gender in the experimental group and the control group, there was no significant difference (p=0.899) between two groups, thereby having been equivalent. Even as for a difference by school year in school type (p=0.952), there was no difference (p=0.800) between two groups as well, thereby having been homogeneous. Both a school record (p=0.926) and a monthly allowance (p=0.646) had no significant difference between the experimental group and the control group. Even in the items of asking about religion (p=0.420), personality type (p=0.085), and parents' job (p=0.900), there was no significant difference between two groups, thereby having been equivalent group (Table 1).

Table 1. Homogeneity for general characteristics (N=42).

Classification	Subdivision	Experimental (n=20)		Control group (n=21)		χ^2	p
		n	(%)	n	(%)		
Gender	Male	14	33.3	15	35.7	0.016	0.899
	Female	6	14.3	7	16.7		
School Type	National	8	19	9	21.4	0.004	0.952
	Private	12	28.6	13	31		

Grade	1	6	14.3	6	14.3	0.445	0.8
	2	9	21.4	12	28.6		
	3	5	11.9	4	9.5		
School grades	Below 60 score	3	7.1	2	4.8	0.89	0.926
	61-70 score	3	7.1	4	9.5		
	71-80 score	5	11.9	4	9.5		
	81-90 score	7	16.7	10	23.8		
	Score over 90	2	4.8	2	4.8		
One month's allowance	Less than 20,000 won	7	16.7	9	21.4	2.494	0.646
	20,000-40,000 won	6	14.2	3	7.1		
	40,000-60,000 won	5	11.9	7	16.7		
	60,000-80,000 won	0	0	1	2.4		
	80,000-100,000 won	2	4.8	2	4.8		
Religion	Buddhism	3	7.1	2	4.8	2.821	0.42
	Christian	4	9.5	0	0		
	Catholic	2	4.8	8	19		
	none	11	26.2	12	28.6		
Personality type	Introspective	18	42.9	15	35.7	2.926	0.085
	Extrovert	2	4.8	7	16.6		
Parent career	Commerce	2	4.8	1	2.4	1.61	0.9
	industry employee	1	2.4	3	7.1		
	Office worker	6	14.3	7	16.7		
	officiar	2	4.8	3	7.1		
	Profession	6	14.3	5	11.9		
	self-employme	3	7.1	3	7.1		

Homogeneity of outcome variables: The academic stress stood at 172.45 ± 28.61 points in the experimental group and 177.27 ± 32.83 points in the control group. Thus, there was no statistically significant difference between two groups (t=-0.50, p=0.911). The academic self-efficacy amounted to 105.55 ± 10.08 points and 104.55 ± 10.06 points. Thus, there was no statistically significant difference between two groups (t=0.32, p=0.964). The suicidal ideation came to 1.70 ± 3.08 points in the experimental group and 1.95 ± 3.44 points in the control group. Thus, there was no statistically significant difference between two groups (t=-0.25, p=0.716). The salivary cortisol reached 1.60 ± 0.83 points in the experimental group and 1.82 ± 0.84 points in the control group. Thus, there was no statistically significant difference between two groups (t=-0.81, p=0.904). (Table 2).

Table 2. Homogeneity of outcome variables (N=42).

Variables	Group	n	M	SD	t	p
Academic stress	Experimental	20	172.45	28.61	-0.5	0.911
	Control group	22	177.27	32.83		
Academic self-efficacy	Experimental	20	105.55	10.08	0.32	0.964
	Control group	22	104.55	10.06		
Suicidal ideation	Experimental	20	1.7	3.08	-0.25	0.716
	Control group	22	1.95	3.44		
Salivary cortisol	Experimental	20	1.6	0.83	-0.81	0.904
	Control group	22	1.82	0.84		

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p=0.964). The suicidal ideation came to 1.70 ± 3.08 points in the experimental group and 1.95 ± 3.44 points in the control group. Thus, there was no statistically significant difference between two groups (t=-0.25, p=0.716). The salivary cortisol reached 1.60 ± 0.83 points in the experimental group and 1.82 ± 0.84 points in the control group. Thus, there was no statistically significant difference between two groups (t=-0.81, p=0.904) (Table 2).

Verification of hypotheses

Hypothesis 1: There will be a difference in academic stress between the experimental group with the application of aromatherapy and the control group. While the academic stress was decreased 70.70 ± 35.35 in the experimental group, it was reduced 6.22 ± 16.84 in the control group. Thus, there was a statistically significant difference between two groups (t=-8.52, $p \leq 0.001$). Accordingly, Hypothesis 1 was supported (Table 3).

Hypothesis 2: There will be a difference in academic self-efficacy between the experimental group with the application of aromatherapy and the control group. While the academic self-efficacy was increased -18.50 ± 12.80 in the experimental group, it was diminished 5.28 ± 8.54 in the control group. Thus, there was a statistically significant difference between two groups (t=8.78, $p \leq 0.001$). Accordingly, Hypothesis 2 was confirmed (Table 3).

Hypothesis 3: There will be a difference in suicidal ideation between the experimental group with the application of aromatherapy and the control group. While the suicidal ideation was dropped 1.00 ± 3.93 in the experimental group, it was grown -0.05 ± 2.93 in the control group. However, there was no statistically significant difference between two groups (t=-1.35, p=0.184). Hence, Hypothesis 3 was rejected (Table 3).

Hypothesis 4: There will be a difference in salivary cortisol between the experimental group with the application of aromatherapy and the control group. While the salivary cortisol was fallen 0.85 ± 0.71 in the experimental group, it was decreased 0.20 ± 1.20 in the control group. Thus, there was a statistically significant difference between two groups (t=-3.85, $p \leq 0.001$). Accordingly, Hypothesis 4 was supported (Table 3).

Table 3. *Comparison of outcome variables between two groups (N=42).*

Variables	Group	Experimental		Control group		t	p
		M	SD	M	SD		
Academic stress	Pre-test	172.45	28.61	177.27	32.83	-8.52	<0.001
	post-test	101.75	16.68	171.05	32.67		
	difference	70.7	35.35	6.22	16.84		
Academic self-efficacy	Pre-test	105.55	10.08	104.55	10.06	8.78	<0.001
	post-test	124.05	8.43	99.27	9.71		
	difference	-18.5	12.8	5.28	8.54		
Suicidal ideation	Pre-test	1.7	3.08	1.95	3.44	-1.35	0.184
	post-test	0.7	2.69	2	3.45		
	difference	1	3.93	-0.05	2.93		
Salivary cortisol	Pre-test	1.6	0.83	1.82	0.84	-3.85	<0.001
	post-test	0.76	0.34	1.63	0.95		
	difference	0.85	0.71	0.2	1.2		

Discussion

As adolescence is the period of falling into a lot of worries, conflicts and confusions with repeating the physically and emotionally rapid change and growth, the necessity for improving the coping ability using a self-intervention method is being mounted so that imminent stress can be well managed. As the aromatherapy is an alternative remedy available for supplementing drug treatment and a continuous self-management method, an interest in aromatherapy is being grown. Hence, this study was progressed with the randomized control group pre-post test design in order to grasp the effects of using aromatherapy in middle school students on academic stress, academic self-efficacy, suicidal ideation, and salivary cortisol.

There was a significant reduction in academic stress of middle school students with the application of aromatherapy. What the academic stress declined significantly compared to before the treatment is an outcome that is consistent with the researches of having reported that there was an effect of a drop in the academic stress of students after applying a program of coping with academic stress [2,6]. Aromatherapy had an effect even on the enhancement in the academic self-efficacy of middle school students. This is thought to have influenced the improvement in academic self-efficacy as a reduction in

academic stress leads to a fall in great pressure and to a relative rise in self-confidence. This outcome is considered to have significantly influenced a decrease in academic stress by which the ingredient of α-pinene in aroma essential oil showed an effect of relieving stress and by which the application with blending more than 2 aroma essential oils rather than one kind of aroma essential oil indicated synergic effect. Through the results of this study, it is thought to be likely capable of getting over stress by perceiving own stress oneself as for academic stress with the application of aromatherapy and by applying oneself a plan for coping with this.

The application of aromatherapy had no significant downturn in the suicidal ideation of middle school students. It was shown that there is no significant difference in suicidal ideation despite having a diminution in academic stress and a growth in academic self-efficacy. This is thought that school environment, family relation, neighborhood environment, friendship, and home environment might have complex influence upon suicidal ideation.

Adolescents are leading a life amidst the context dubbed interpersonal relation in which a social relationship needs to be maintained with parents, friends, and teachers as well as getting many pressures from academic matter, home issue, problem about a friend, and ego issue. In addition, adolescence is the turbulent era with the fastest physical, emotional and intellectual change and is also the period of having failed to form an integrative image on self yet [1]. In this way, the youths are in the period that a relationship with the surrounding others is very important and in the age that how oneself looks like to other people is crucial, and are simultaneously lacking even in a perception on self, thereby being apt to recognize oneself as a worthless existence with literally accepting others' negative evaluation, and having possibility of likely causing a big pain, resulting in seeming to have influence upon suicidal ideation. Thus, it is considered to be likely to be necessarily continued a research on factors resulting from situational distinctiveness in Korean adolescents. This study could be confirmed that the application and inhalation of aroma essential oil has an effect on a reduction in cortisol, which is a hormone of becoming the indicator of stress.

It is consistent with the research results that the concentration in salivary cortisol was insignificant in the experimental group with the inhalation of a necklace in aroma scent only during the daytime, but that the concentration of salivary cortisol decreased significantly in the experimental group of having inhaled again after the period of washing out for 2 weeks [24]. As cortisol is a glucocorticoid hormone that is produced in the adrenal cortex, it is secreted with responding to a lot of biochemical stimulus and mental and social stimulus. Cortisol is being regarded as a biological indicator that was changed with responding to stressful stimulation. In traditionally performing a research of cortisol using blood sample, a side effect was magnified an ethical and methodological matter as well as economical aspect. Thus, the measurement of cortisol in the saliva is being much used in a research. Aroma essential oil ingredients remain in the body from several hours to a few days and continue the healing process [25]. This study compositively applied the inhalation method through olfactory sense and the application method for absorbing through the skin, thereby having made aroma essential oil ingredients available for the systemic circulation through the capillary and lymph circulation. Also, it is considered that the application with blending in the proportion of 8% in Roman Chamomile essential oil, which contains the ingredients of α-pinene, β-pinene to relieve anxiety & stress and to calm the nerves, and of 5% in Lavender essential oil, 2% in Rosemary essential oil, and 5% in rose essential oil, controlled a source of stress with a continuous effect of essential oil, thereby having activated the response of the parasympathetic nervous system.

In light of the above findings, the application of aromatherapy is considered to be likely to be highly useful as a complementary and alternative therapy, which is helpful for alleviating academic stress and improving academic self-efficacy in middle school students. The aromatherapy of using aroma stick was confirmed to be a stress management method available for reducing academic stress. It can be considered to have a significance in providing objective and scientific outcome in order to be possibly utilized as a reference material in a follow-up research as the randomized control group pre-post test design. The application of aromatherapy to the academic stress management has significance in conforming flow of health management in modern society of pursuing a natural healing method through alternative therapy and in arranging a scientific basis on proving an effect of a complementary and alternative therapy.

Conclusion and Suggestion

As this is a study in the randomized control group pre-post test design that applied with making aroma essential oil in the form of aroma stick so that continuous management can be easy, it proved the effective intervention method available for being used in alleviating academic stress and enhancing academic self-efficacy in middle school students by objectively verifying an effect of aroma essential oil. Also, a useful method was suggested that even the middle school students as the stressful youths can easily use with having an interest in own health promotion. The intervention of aromatherapy using aroma essential oil has significance in corresponding to a flow of stress and health management in modern times of pointing to a natural healing method focusing on a concept of wellbeing, and in offering a scientific basic of a complementary and alternative therapy.

Based on the above conclusions, the following suggestions are aimed to be made. There is a need to closely examine whether there is a difference depending on a method of applying aroma essential oil. A comparative research is considered to be likely necessary with other aroma essential oil that is known to have an effect of relieving stress. Also, a continuous research is needed on the appearance of continuity in aroma essential oil, immune tolerance, administration time, and administration frequency.

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