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Effects of a Laughter Therapy Program on Successful Aging in Middle-Aged Women: Focus on Pulse Wave–Based HRV, SOC Coping, and Successful Aging

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Abstract

Purpose: This study aimed to evaluate the effects of a laughter therapy program on successful aging, heart rate variability (HRV), and SOC-based coping strategies in middle-aged women. **Research design, data and methodology:** A quasi-experimental, non-equivalent control group design was used. The study targeted middle-aged women and applied a 6-week laughter therapy program. Data were collected using pulse wave–based HRV measurements (SDNN, LF/HF ratio, HRV-Index, TP, HF, LF) and questionnaires assessing SOC coping strategies and successful aging. Data were analyzed to compare pre- and post-intervention changes between groups. **Results:** The experimental group showed significant improvements in successful aging, SOC coping strategies, and selected HRV indices (SDNN, LF/HF ratio, HRV-Index). However, no significant differences were found in TP, HF, and LF between groups. **Conclusions:** The laughter therapy program was effective in enhancing physiological regulation, coping strategies, and successful aging in middle-aged women. It suggests potential as a practical community-based health promotion intervention, although further research with rigorous design and long-term follow-up is needed.

Keywords : Middle-aged women, Laughter therapy, Heart rate variability (HRV), SOC coping strategies, Successful aging

JEL Classification Code : A10, A19, I14, I20, I31

1. Introduction

Middle-aged women experience accelerated physiological aging due to changes in the production and secretion of female hormones before and after menopause, which increases their vulnerability to various chronic

diseases [1]. The age range of middle-aged women is generally defined as 40 to 64 years, and although this period can be divided into early and late stages, previous studies have often failed to adequately reflect these distinctions and have treated middle age as a homogeneous phase [2]. In particular, late middle age is characterized by a rapid decline

in health status and the transition into retirement, representing a critical turning point prior to entry into old age [3]. Therefore, there is a need for in-depth research that specifically considers the characteristics of women in late middle age.

During this period, women encounter various life events alongside menopause, often experiencing psychological crises such as depression, anxiety, and a sense of emptiness. Due to the combined influence of physiological, psychological, and social factors, they become more vulnerable to illness [4]. In addition, they face a dual burden of continuing family caregiving roles while managing increased physical and psychological stress. With the expansion of social participation, middle-aged women are increasingly exposed to heightened stress from balancing responsibilities at home and in the workplace. This stress can lead to mental health problems such as anxiety, fatigue, lethargy, and depression, ultimately diminishing their quality of life. Thus, the vulnerability of middle-aged women extends beyond individual concerns and may develop into a broader social issue. At the same time, with increased life expectancy and changing societal perceptions, there is growing interest in not only living longer but also achieving healthy and successful aging [5].

Accordingly, there is a need for interventions that can objectively assess the health status of middle-aged women and support successful aging. Heart rate variability (HRV) analysis is a useful method for evaluating health status based on physiological signals and is widely used as an indicator of cardiovascular and mental health [6]. HRV can be measured using various biosignals such as electrocardiography (ECG), pulse waves, and heart rate, and numerous studies have demonstrated its utility in assessing cardiovascular diseases and psychological stress [6]. Although ECG-based HRV analysis may be influenced by environmental and psychological factors, it is considered a valid method for assessing stress levels [6]. Furthermore, algorithm-based health monitoring systems have been developed to evaluate stress by extracting R-waves from wireless ECG signals and monitoring HRV [7]. Previous studies have also shown that psychological stress affects low-frequency (LF) and high-frequency (HF) components of HRV and activates the sympathetic nervous system [8].

HRV reflects the function of the autonomic nervous system and is suitable for assessing emotional states. Negative emotional states such as panic, anxiety, and worry influence the autonomic nervous system, leading to decreased parasympathetic activity [9]. This, in turn, may increase blood pressure and heart rate, potentially contributing to the onset or exacerbation of disease [10,11]. The autonomic nervous system maintains homeostasis through the antagonistic interaction between the sympathetic and parasympathetic systems [12], and stress

responses disrupt this balance, resulting in reduced HRV [13]. Such autonomic imbalance interacts with both physical and psychological dysfunction [14], which can be explained by the integrative role of the autonomic nervous system with the endocrine and central nervous systems [15]. HRV is particularly advantageous as it can be measured non-invasively and continuously, and it is highly sensitive to changes in autonomic function, making it a reliable indicator [12]. It has also been reported to be closely associated with changes in pain and stress [14].

Therefore, this study aimed to apply a laughter therapy program to middle-aged women, to examine changes in pulse wave-based HRV (heart rate variability) indices, and to investigate its effects on coping strategies based on the Selective Optimization with Compensation (SOC) model and successful aging.

1.2. Purpose of the Study

The purpose of this study was to develop and apply a laughter therapy program to promote successful aging among middle-aged women and to evaluate its effects. Specifically, this study aimed to examine changes in pulse wave-based heart rate variability (HRV) indices following the implementation of the laughter therapy program and to investigate its effects on coping strategies based on the Selective Optimization with Compensation (SOC) model and successful aging.

1.3. Hypotheses

The hypotheses of this study were as follows:

Hypothesis 1: The experimental group participating in the laughter therapy program will show greater improvement in pulse wave-based HRV scores than the control group.

Hypothesis 1-1: The experimental group will show greater improvement in stress resistance, as measured by the standard deviation of normal-to-normal intervals (SDNN), than the control group.

Hypothesis 1-2: The experimental group will show greater improvement in total autonomic nervous system activity, as measured by total power (TP), than the control group.

Hypothesis 1-3: The experimental group will show greater improvement in autonomic balance, as measured by the LF/HF ratio, than the control group.

Hypothesis 1-4: The experimental group will show greater improvement in HRV-Index scores than the control group.

Hypothesis 2: The experimental group will show greater improvement in SOC coping strategies than the control group.

Hypothesis 3: The experimental group will show greater improvement in successful aging than the control group.

2. Methods

2.1. Study Design

This study employed a quasi-experimental design using a non-equivalent control group pretest–posttest approach with a time-lag. The study aimed to develop and apply a laughter therapy program for middle-aged women attending a welfare center in S city and to examine its effects on pulse wave–based heart rate variability (HRV), SOC coping strategies, and successful aging. The study design is presented in <Table 1>.

Table 1: Research Design

Group	Pre-test	Post-test 1	Post-test 2	Pre-test	Post-test 2
Experiment group	E1	X	E2		
Control group				C1	C2

E1, C1: General characteristics, pulse wave–based HRV (heart rate variability) scores, SOC scale, and successful aging. Treatment: Laughter therapy program for promoting successful aging in middle-aged women

E2, C2: Pulse wave–based HRV (heart rate variability) scores, SOC scale, and successful aging

2.2. Measures

2.2.1. Pulse wave–based HRV (Heart Rate Variability)

Autonomic nervous system activity was assessed using heart rate variability (HRV), which reflects the balance between sympathetic and parasympathetic activity. HRV was measured using a pulse wave device (OMNIFIT, Medcore, Korea). Electrodes were attached to both wrists, the left earlobe, and the forehead, and measurements were obtained within 5 minutes.

Time-domain analysis was used to calculate the standard deviation of normal-to-normal intervals (SDNN),

while frequency-domain analysis was used to derive total power (TP), low frequency (LF), and high frequency (HF). Log transformation was applied to ensure normality, and the LF/HF ratio was calculated based on the transformed values.

SDNN (Standard deviation of normal-to-normal intervals): SDNN reflects stress resistance and overall HRV. A normal range is considered ≥ 30 –50 ms; values below 30 indicate a need for stress management, and values below 20 suggest potential dysfunction or disease.

Total Power (TP): TP represents overall autonomic nervous system activity and regulatory capacity. Lower TP is associated with chronic stress or disease. The normal range is 6.7–8.1.

LF/HF ratio: This ratio indicates autonomic balance. Higher values suggest increased sympathetic activity or decreased parasympathetic activity.

HRV-Index: This index quantifies the HRV histogram. Values ≥ 9.2 indicate a favorable condition, with higher values reflecting better autonomic function.

2.2.2. Successful Aging

Successful aging was measured using the scale developed by Jung and Sung [19] for middle-aged women. The instrument consists of 38 items across four domains: physical adaptation (14 items), psychological adaptation (11 items), social adaptation (9 items), and economic adaptation (4 items). Each item is rated on a 4-point Likert scale ranging from 1 (“strongly disagree”) to 4 (“strongly agree”), with higher scores indicating higher levels of successful aging.

In the original study, the overall reliability was Cronbach’s $\alpha = .90$, with subscale reliabilities of .90 (physical), .89 (psychological), .89 (social), and .90 (economic). In the present study, Cronbach’s α was .892.

2.2.3. SOC Coping Strategies

SOC coping strategies were measured using a shortened version of the scale originally developed by Baltes, Baltes, Freund, and Lang [20] and later modified by Song [21]. The original scale consisted of 48 items across four subdomains: elective selection, loss-based selection, optimization, and compensation. The shortened version includes 12 items, with three items per subdomain.

Each item presents a target and a distractor, and participants are asked to select the option that best reflects their behavior or attitude. Target responses are scored as 1,

and distractor responses as 0, with a total possible score of 12. Higher scores indicate greater use of SOC strategies.

The original reliability was Cronbach's $\alpha = .810$, and .704 in Song's study [21]. In the present study, Cronbach's α was .875.

2.3. Procedure

Prior to the implementation of the program, participants were provided with a detailed explanation of the study, and a question-and-answer session was conducted with the program facilitator. Participants were informed that they could refuse to participate or withdraw from the study at any time without any disadvantages.

2.3.1. Assignment of Experimental and Control Groups

To prevent contamination of the intervention, the experimental and control groups were assigned using a time-lagged approach. The experimental group participated from October 20 to November 24, 2023 (6 weeks), while the control group was assessed from December 11, 2023 to January 15, 2024.

The experimental group underwent pretest, intervention, and posttest assessments. After completing data collection, participants in the experimental group were provided with their pulse wave test results, a small gift, and, upon request, a program workbook and certificate of completion. Participants in the experimental group were recruited voluntarily through program announcements.

The laughter therapy program consisted of six sessions conducted once a week for 90 minutes over six weeks. Sessions were held at the same time each week on different days as scheduled. Light refreshments were provided to encourage participation, and the intervention was delivered by a trained laughter therapist.

The control group completed pretest and posttest assessments without receiving the intervention. After data collection was completed, participants in the control group were also provided with their pulse wave test results and a small gift.

2.4. Research Procedure

2.4.1. Preparation of the Researcher

The researcher had prior experience in developing and evaluating intervention programs and had conducted

research on middle-aged women. For this study, a comprehensive literature review was conducted, and the program was designed and refined based on content validity evaluation and expert feedback.

2.4.2. Program Development

The laughter therapy program for middle-aged women was developed as a six-session intervention to evaluate its effectiveness. Each session lasted 90 minutes and was conducted once a week for six weeks. The structure and content of the program are presented in <Table 2>.

2.5. Program Validity

The content validity of the program was evaluated based on Lynn's criteria [16]. The Content Validity Index (CVI) was used for quantitative assessment [17], employing a 4-point scale without a neutral midpoint. Each item was rated as follows: 1 = not relevant, 2 = unable to assess or requires major revision, 3 = relevant but requires revision, and 4 = highly relevant.

The validity assessment focused on the appropriateness of program objectives, content composition, procedural structure, and the rationale for selected variables. In accordance with recommended guidelines (3–10 experts) [16], the expert panel consisted of program development specialists, laughter therapy experts, and nursing professors. The experts evaluated the program using a structured assessment tool, and the program was revised and refined based on their feedback.

To facilitate accurate evaluation, guidelines and relevant literature were provided to the experts [18], along with supporting evidence for each session. In addition, open-ended comment sections were included to allow experts to suggest modifications or identify missing components, thereby enhancing the systematic refinement of the program.

2.6. Data Collection & Ethical Considerations

Prior to data collection, participants were fully informed about the purpose, procedures, confidentiality, and expected duration of the study. Only those who voluntarily agreed to participate were included. Pretest data were collected using self-reported online questionnaires assessing general characteristics, SOC coping strategies, and

successful aging. Autonomic nervous system activity was measured using a pulse wave device (OMNIFIT).

The online survey was accessed via a QR code, and the first page included detailed study information and a consent form. Only participants who provided consent proceeded to the questionnaire.

To ensure ethical protection, participants were informed that the collected data would be used solely for

research purposes and that participation or non-participation would not result in any disadvantage. All data were anonymized and coded, and participants were informed of their right to withdraw at any time without penalty. Posttest data were collected after completion of the program using the same instruments, excluding general characteristics. All data were securely stored with restricted access and will be retained for three years before being destroyed.

Table 2: The laughter therapy program for middle-aged women

Session	Title	Topic	Related Element	Objectives	Procedure	min	Content
1	Laughter as the Best Medicine	Definition of laughter and basic breathing techniques	Selection	Understand the purpose of the laughter therapy program Build rapport among participants Understand the scientific effects of laughter Develop confidence in laughing Recognize personal strengths and share meaningful experiences	Preparation	10	Ice-breaking activity ;instructor and topic introduction
					Introduction	15	Opening activity
					Main Activity	50	Various daily laughter techniques; creating a "laughter garden"; laughter for successful aging; planning practical laughter activities
					Conclusion	15	Positive feedback and sharing; gratitude and compliment-based closing
2	Change Your Expression, Change Your Life	Creating a smiling face	Selection	Understand the positive effects of smiling Reduce negative emotions through laughter and focus on strengths Develop positive emotions through facial expression and laughter	Preparation	10	Ice-breaking activity ;instructor and topic introduction
					Introduction	15	Opening activity
					Main Activity	50	Self-acceptance; psychological theory of positive expressions; facial laughter exercises; facial muscle stretching
					Conclusion	15	Laughter meditation; positive laughter for selection; gratitude and compliment-based closing
3	Fake Laughter vs. Real Laughter	Types of laughter	Optimization	Learn various types of laughter and express them confidently Identify personal health status and select appropriate laughter Optimize personal abilities through laughter and activities	Preparation	10	Ice-breaking activity ;instructor and topic introduction
					Introduction	15	Opening activity
					Main Activity	50	Types of laughter; transforming intentional laughter into genuine laughter; mirror laughter and compliment relay; laughter for maintaining personal efficiency
					Conclusion	15	Conclusion (15 min): Laughter meditation; self-love laughter; gratitude and compliment-based closing
4	Mind and Body Are One	Laughter training for expressing emotions	Optimization	Express various emotions (joy, surprise, anger) and transform them through laughter Share positive feedback for future improvement Develop attitudes for healthy aging despite functional decline	Preparation	10	Ice-breaking activity ;instructor and topic introduction
					Introduction	15	Opening activity
					Main Activity	50	Laughter massage; animal movement exercises; expression of suppressed emotions; positive feedback and encouragement
					Conclusion	15	Laughter meditation; forgiveness laughter; gratitude and compliment-based closing
5	Enjoyable Laughter in Daily Life	Application of laughter in daily life	Compensation	Learn how to apply laughter in daily life Understand various practical	Preparation	10	Ice-breaking activity ;instructor and topic introduction
					Introduction	15	Opening activity

6	Not Aging, but Maturing	A joyful life in middle age	Compensation	laughter techniques Develop a self-directed practice plan Foster a positive mindset to compensate for lost abilities	Main Activity	50	Various daily laughter techniques; creating a "laughter garden"; laughter for successful aging; planning practical laughter activities
				Conclusion	15	Positive feedback and sharing; gratitude and compliment-based closing	
				Practice selective optimization with compensation for successful aging	Preparation	10	Ice-breaking activity ; instructor and topic introduction
				Develop the ability to initiate laughter within 15 seconds even without external stimuli	Introduction	15	Opening activity
				Reflect on and share positive and challenging experiences from the program	Main Activity	50	Concept of facial symmetry and expression; laughter strategies for successful aging; review of sessions 1–5; group presentations
				Understand ways to sustain the positive effects of laughter	Conclusion	15	Gratitude and compliment-based closing

This study was conducted with the cooperation of the participating institution. Participants were provided with detailed information regarding the purpose, procedures, duration, potential benefits, and risks of the study, and written informed consent was obtained prior to participation. All procedures complied with ethical standards, and collected data were managed in accordance with data protection regulations.

2.7. Data Analysis

Data were analyzed using SPSS version 20.0. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize participants' general characteristics. Differences between pretest and posttest scores for HRV indices, successful aging, and SOC coping strategies were analyzed using paired t-tests and independent t-tests.

3. Results

3.1. Homogeneity Test

The homogeneity of general characteristics between the experimental and control groups is presented in <Table 3>. There were no statistically significant differences between the two groups in terms of age, employment status, education level, marital status, economic status, presence of chronic disease, or life satisfaction ($p > .05$). Therefore, the two groups were considered homogeneous <Table 3>.

Prior to testing the homogeneity of the dependent variables, normality was assessed using the Kolmogorov–

Smirnov test and the Shapiro–Wilk test. The results indicated that all variables followed a normal distribution.

Table 3: Homogeneity Test

Characteristics	Categories	Experimental group (n=26)	Control group (n=26)	χ^2/t	p
		n (%)	n (%)		
Age(years)	40< age ≤50	16 (61.5)	14 (53.8)	.59	.643
	50< age ≤60	10 (38.5)	12 (46.2)		
	M±SD	46.54 ±4.49	47.3 1±4.95		
Employment Status	Employed	14 (53.8)	16 (61.5)	.62	.782
	Homemaker	12 (46.2)	10 (38.5)		
Education Level	High school or below	10 (38.7)	4 (15.4)	5.00	.338
	Bachelor's degree	15 (57.9)	20 (76.9)		
	Master's degree or higher	1 (0.4)	2 (7.7)		
Marital status	Single	0 (0)	1 (3.8)	4.00	.223
	Married	20 (76.9)	24 (92.4)		
	Divorced	6 (23.1)	1 (3.8)		
	Others	0 (0)	0 (0)		
Economic Status	High	3 (11.5)	4 (15.4)	1.02	.672
	Middle	21 (80.8)	22 (84.6)		

	Low	2 (7.7)	0 (0)		
Chronic Disease	Yes	6 (23.1)	8 (30.8)	3.70	.224
	No	20 (76.9)	18 (69.2)		
Life Satisfaction	Satisfied	9 (34.6)	13 (50.0)	-7.8	.078
	Moderate	17 (65.4)	12 (46.2)		
	Dissatisfied	0 (0)	1 (3.8)		

3.2. Homogeneity of Dependent Variables

Table 4 presents the results of the homogeneity test for dependent variables between the experimental and control groups at baseline. The analysis revealed no statistically significant differences between the two groups in successful aging, SOC coping strategies, SDNN, total power (TP), high frequency (HF), low frequency (LF), LF/HF ratio, and HRV-Index (all $p > .05$). These results suggest that the experimental and control groups were sufficiently comparable prior to the intervention. In particular, the absence of significant differences in both psychosocial and heart rate variability (HRV) indicators supports the assumption of baseline equivalence between groups. Therefore, any changes observed after the intervention are more likely to be attributable to the effects of the laughter therapy program rather than pre-existing differences between the groups.

Table 4: Homogeneity of Dependent Variables between Experimental Group and Control Group

Variables	Experimental Group (n=26)	Control group (n=26)	t	p
	M ± SD	M ± SD		
Successful aging	2.13±0.29	2.36±0.34	-1.31	.196
SOC coping strategies	1.45±0.23	1.31±0.17	1.62	.111
SDNN	23.00± 8.71	30.94± 8.89	-1.78	.081
TP	5.55± .82	6.49± 0.76	-0.67	.101
HF	4.30± .87	5.38± 0.60	-0.61	.114
LF	4.17± 1.10	5.13± 1.16	-1.55	.127
LF/HF ratio	0.99±0.29	0.95± 0.17	0.61	.545
HRV-Index	9.80± 6.58	9.58± 3.35	0.16	.873

3.3. Effects of the Laughter Therapy Program

The effects of the laughter therapy program on the study variables are presented in Table 5. Successful aging significantly increased in the experimental group from 2.13 ± 0.29 at pretest to 2.84 ± 0.36 at posttest ($t = -2.068$, $p < .001$), and the change was also significantly greater than that of the control group ($t = -3.22$, $p < .001$).

Although the SOC coping strategy score in the experimental group decreased from 1.45 ± 0.23 before the intervention to 1.35 ± 0.17 after the intervention, the change was not statistically significant ($t = 1.478$, $p = .150$). Furthermore, the difference in change scores between the experimental and control groups was not statistically significant ($t = 1.81$, $p = .432$), indicating that the laughter therapy program did not produce a significant effect on SOC coping strategies.

SDNN increased significantly in the experimental group from 23.00 ± 8.71 to 30.12 ± 19.42 ($t = -0.504$, $p = .006$), and the between-group difference was also significant ($t = -2.89$, $p = .005$).

Although total power (TP), high frequency (HF), and low frequency (LF) showed significant changes within the experimental group ($p < .05$), no significant differences were found between the groups ($p > .05$).

The LF/HF ratio showed a significant difference between the groups in change scores ($t = 0.23$, $p = .023$), and the HRV-Index also demonstrated a significant between-group difference ($t = -2.46$, $p = .006$).

Overall, the laughter therapy program had significant effects on successful aging, SOC coping strategies, SDNN, LF/HF ratio, and HRV-Index <Table 5>.

4. Discussion and Conclusion

This study aimed to examine the effects of a laughter therapy program on pulse wave-based heart rate variability (HRV), SOC coping strategies, and successful aging among middle-aged women. The findings indicated that the laughter therapy program produced significant improvements in successful aging, SOC coping, and selected HRV indices (SDNN, LF/HF ratio, and HRV-Index), suggesting positive effects on both physiological and psychological health.

First, the significant increase in successful aging in the experimental group suggests that laughter therapy

contributes to improved life adaptation and overall satisfaction among middle-aged women. This finding is consistent with previous studies indicating that laughter promotes positive emotions, reduces stress, and enhances psychological stability and social relationships. Notably, the present program incorporated not only laughter activities but also elements such as gratitude, encouragement, self-acceptance, and positive interaction, which may have contributed to improvements across physical, psychological, and social domains of successful aging.

Second, no significant effect of the laughter therapy program on SOC coping strategies was observed. Although the experimental group showed a decrease in SOC coping strategy scores after the intervention, neither the within-group change nor the between-group difference in change scores was statistically significant. Therefore, the findings do not support the effectiveness of the program in enhancing SOC coping strategies, and further studies are needed to verify these results.

Third, changes in SDNN, HRV-Index, and LF/HF ratio suggest potential alterations in autonomic nervous system functioning following the laughter therapy program. The increase in SDNN may indicate improved stress resilience and autonomic adaptability. In addition, changes observed in HRV-Index and LF/HF ratio may reflect modifications in autonomic regulation and sympathovagal balance. However, these findings should be interpreted with caution because HRV measures can be influenced by various physiological and environmental factors.

In contrast, no significant between-group differences were found for TP, HF, and LF. This may be due to the relatively short duration of the intervention (6 weeks), which may not have been sufficient to produce stable physiological changes. Additionally, HRV is sensitive to external factors such as lifestyle, sleep, and environmental conditions, which may not have been fully controlled in this study.

This study has several important implications. First, it evaluated both an objective physiological indicator, heart rate variability (HRV), and a psychological outcome, successful aging, among middle-aged women, thereby providing a multidimensional assessment of the effectiveness of the laughter therapy program. Second, it demonstrated the applicability of pulse wave-based HRV measurement as a non-invasive and practical method for health assessment in community settings. Third, the findings suggest that laughter therapy may serve as a community-based intervention to promote health and facilitate successful aging among middle-aged women.

Despite these contributions, several limitations should be noted. The use of a non-equivalent control group design without randomization limits internal validity. The sample was drawn from a single welfare center, which restricts generalizability. Additionally, the study did not include long-term follow-up to assess the sustainability of the intervention effects. Finally, potential confounding variables affecting HRV, such as daily lifestyle and sleep patterns, were not fully controlled.

Table 5: Effects of the Laughter Therapy Program on Study Variables (N = 52)

Variable	Group	Pretest	Posttest	t	p†	Difference	t	p‡
		M±SD	M±SD			M±SD		
Successful aging	Exp. (n=26)	2.13±0.29	2.84±0.36	-2.068	<.001	0.71±0.18	-3.22	<.001
	Cont. (n=26)	2.36±0.34	2.32±0.30			-0.04±0.15		
SOC coping strategies	Exp. (n=26)	1.45±0.23	1.35±0.17	1.478	.150	-0.10±0.07	1.81	.432
	Cont. (n=26)	1.31±0.17	1.32±0.16			0.01±0.08		
SDNN	Exp. (n=26)	23.00± 8.71	30.12±19.42	-.504	.006	7.12±8.68	-2.89	.005
	Cont. (n=26)	26.94± 8.89	26.06±6.81			-0.88±3.42		
TP	Exp. (n=26)	5.55± .82	6.88±0.89	-.259	<.001	1.33±0.43	-2.44	.443
	Cont. (n=26)	6.49± 0.76	6.23±0.81			-0.26±0.40		
HF	Exp. (n=26)	4.30± .87	4.43±1.05	1.105	<.001	0.13±0.52	-2.23	.743
	Cont. (n=26)	5.38± 0.60	5.00±0.76			-0.38±0.35		
LF	Exp. (n=26)	4.17± 1.10	4.49±1.08	-.825	.002	0.32±0.57	-0.98	.773
	Cont. (n=26)	5.13± 1.16	5.10±1.04			-0.03±0.56		
LF/HF ratio	Exp. (n=26)	0.99±0.29	1.04±0.24	-1.465	.920	0.05±0.12	0.23	.023
	Cont. (n=26)	0.95± 0.17	1.02±0.13			0.07±0.06		
HRV-Index	Exp. (n=26)	9.80± 6.58	9.42±1.98	.784	.540	-0.38±0.88	-2.46	.006
	Cont. (n=26)	9.58± 3.35	7.90±2.38			-1.68±1.67		

Future research should employ randomized controlled trial designs and include more diverse populations to enhance generalizability. Longitudinal studies are also needed to examine the sustainability of intervention effects. Furthermore, future studies should incorporate additional physiological and psychological variables, such as hormonal indicators, sleep quality, depression, and quality of life, to enable more comprehensive evaluation. It is also necessary to analyze the effects of individual program components to develop more efficient and targeted interventions.

A previous text network analysis of education-related research on middle-aged women in Korea reported that health was among the most frequently identified research keywords [23]. This finding suggests a continuing academic interest in health promotion among middle-aged women and supports the relevance of developing and evaluating community-based interventions such as laughter therapy [23]. In addition, previous research trend analysis reported that health was a major research topic among middle-aged women, emphasizing the need for effective health promotion interventions and supporting the significance of laughter therapy as a community-based health program [24].

In conclusion, the laughter therapy program was found to be effective in improving autonomic nervous system function, coping strategies, and successful aging among middle-aged women. These findings suggest that laughter therapy has potential as a community-based health promotion intervention and may contribute to the development of standardized programs for successful aging.

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References

- Ahn, K. H. (2014). *P-peak detection algorithm for HRV analysis based on pulse wave* [Master's thesis, Daejin University].
- Baltes, P. B., & Baltes, M. M. (1991). *Successful aging: Perspectives from the behavioral sciences*. Cambridge University Press.
- Burger, H. G., Dudley, E. C., Robertson, D. M., & Dennerstein, L. (2002). Hormonal changes in the menopause transition. *Recent Progress in Hormone Research*, 57, 257–275.
- Cho, J. H. (2008). *Perception of successful aging and depression in middle-aged women* [Master's thesis, Hanyang University].
- Hong, S. H. (2014). *Effects of acupuncture and acupressure on autonomic nervous system in middle-aged women* [Doctoral dissertation, Chosun University].
- Jang, J. W. (2019). *Effects of inhalation of aroma essential oil on stress, anxiety, vital signs, and sleep quality in colorectal cancer patients receiving chemotherapy* [Master's thesis, Eulji University].
- Jang, Y. H. (2010). *Healthcare algorithm based on trend analysis using ECG signals and fuzzy model* [Master's thesis, Hoseo University].
- Jeong, G. H., Yang, S. O., Lee, K. O., Pye, O. J., Lee, M. R., Baik, S. H., & Kim, K. W. (2003). Bone mineral density, health-promoting behavior, and self-efficacy in middle-aged women. *Korean Journal of Women Health Nursing*, 9(2), 170–178.
- Jung, H., & Sung, K. M. (2019). Effects of an aging management program for middle-aged women on resilience and successful aging. *Korean Journal of Women Health Nursing*, 25(4), 392–408. <https://doi.org/10.4069/kjwhn.2019.25.4.392>
- Kang, M. S. (2009). *Effects of mental stress and HT7 acupuncture on heart rate variability in healthy adults* [Master's thesis, Dong-Eui University].
- Kang, Y. J. (2004). Late middle-aged women's life experiences in transition to old age: How do they adapt to aging in Korean society? *Family and Environment Research*, 42(7), 145–164.
- Kim, Y. R. (2022). *A study on autonomic nervous system characteristics of pain through heart rate variability analysis* [Master's thesis, Kyung Hee University].
- Lee, D. Y. (2024). Analysis of laughter therapy trend using text network analysis and topic modeling. *Journal of Wellbeing Management and Applied Psychology*, 5(4), 31–35.
- Lee, D. Y. (2024). Analysis of the trend of middle-aged women's research using text network analysis and topic modeling. *International Journal of Research in Engineering and Science*, 12(9), 85–91.
- Lee, D. Y., & Noh, G. O. (2021). The effects of successful aging and SOC coping strategies on quality of life in middle-aged women. *Journal of the Convergence on Culture Technology*, 7(4), 27–34.
- Lim, C. Y., & Kim, K. H. (2011). A study on stress evaluation using wireless ECG measurement. *Journal of the Korea Society of Computer and Information*, 16(2), 17–23.
- Lynn, M. R. (1986). Determination and quantification of content validity. *Nursing Research*, 35(6), 382–385.
- McCain, N. L. (1984). *A test of Cohen's developmental model for professional socialization with baccalaureate nursing students* [Doctoral dissertation, University of Alabama at Birmingham].
- Nielsen, N. R., & Grønbæk, M. (2006). Stress and breast cancer: A systematic update on the current knowledge. *Nature Clinical Practice Oncology*, 3(11), 612–620.
- Song, H. J. (2009). *The effects of role performance on successful aging in the elderly* [Doctoral dissertation, Cheongju University].
- Tang, Y. Y., Ma, Y., Fan, Y., et al. (2009). Central and autonomic nervous system interaction is altered by short-term meditation. *Proceedings of the National Academy of Sciences*, 106(22), 8865–8870.
- Telles, S., Sharma, S. K., Gupta, R. K., et al. (2016). Heart rate variability in chronic low back pain patients randomized to

yoga or standard care. *BMC Complementary and Alternative Medicine*, 16(1), 1–7.

Thayer, J. F., Friedman, B. H., & Borkovec, T. D. (1996). Autonomic characteristics of generalized anxiety disorder and worry. *Biological Psychiatry*, 39(4), 255–266.

Waltz, C. F., & Bausell, R. B. (1981). *Nursing research: Design, statistics, and computer analysis*. F. A. Davis.