Original Contribution Kitasato Med J 2024; 54: 42–48

Relationship between the psychological effects of Snoezelen multisensory stimulation and stress reduction

Kana Jitsuhara,[1] Makoto Kubo,[2] Kayoko Takahashi[3]

[1] Functional Restoration Science, Sensory and Motor Control, Graduate School of Medical Sciences, Kitasato University
[2] Department of Medical Laboratory Sciences, School of Allied Health Sciences, Kitasato University
[3] Department of Occupational Therapy, School of Allied Health Sciences, Kitasato University

Objective: This study examined the psychological and physiological relaxation effects of Snoezelen therapy on healthy adult students.
Methods: This prospective crossover study included 20 healthy adult students (10 men, 10 women; age, 21.1 ± 1.4 years). A 15-minute Kraepelin test was administered to induce a mental stress load and then the participants were allowed to rest for 10 minutes in a Snoezelen environment (experimental condition) or a normal room (control condition). The Adult Short Version of the Profile of Mood State, 2nd Edition (POMS 2-AS), the State-Trait Anxiety Inventory (STAI), and psychological measurements of fatigue and physiological measurements of salivary cortisol concentrations were used as indicators. Fatigue was measured using a numerical rating scale. Data were analyzed using a two-factor analysis of variance with the experimental condition and time as independent variables.
Results: A main effect of the time was noted before and after the experimental and control on the POMS 2-AS items of anger–hostility, confusion–bewilderment, fatigue–inertia, tension–anxiety, and total mood disturbance, as well as the STAI (state anxiety) and fatigue. Conversely, the interaction between the experimental condition and time was observed only in STAI (state anxiety) and fatigue.
Conclusion: Multisensory stimulation in a Snoezelen environment reduced mental stress, particularly anxiety and fatigue, in healthy participants.

Keywords: Snoezelen, multisensory stimulation, stress reduction, fatigue, salivary cortisol

Introduction

Modern society is stressful because individuals are exposed to various and constant stressors. Stress strongly affects happiness, health, and cognition and can cause psychological discomfort.[1] It can also cause physical fatigue, including stiff shoulders, headaches, and malaise, which can decrease one's activity levels and daily work performance. When individuals experience an extended period of stress, their minds and bodies may become unbalanced, thereby putting them at risk for stress-related diseases, including depression, anxiety disorders, and psychosomatic disorders. Therefore, to cope with stress and manage their health, individuals must adopt self-care methods that suit their needs.

Various relaxation methods are available for stress relief. For example, aromatherapy and listening to music are easy interventions; therefore, they are frequently used as complementary and alternative ways to alleviate the problems of modern medicine, such as side effects of medication.[2] Moreover, the natural placement of indoor foliage plants has been observed to shorten stress recovery time.[3] Effective relaxation methods for relieving stress comprise sensory stimulation techniques that each individual finds pleasant.

Snoezelen environments have recently attracted attention owing to their relaxation effect. Snoezelen is a type of therapy comprised of a multisensory environment that gently stimulates the 5 human senses with various

Received 5 December 2023, accepted 14 December 2023
Correspondence to: Kana Jitsuhara, Functional Restoration Science, Sensory and Motor Control, Graduate School of Medical Sciences
Kitasato University, 1–15–1 Kitazato, Minami-ku, Sagamihara, Kanagawa 252–0373, Japan
Email: dm20012@st.kitasato-u.ac.jp

visual, auditory, and olfactory inputs, thereby promoting relaxation and interest and enriching the lives of individuals with disabilities.[4] A Snoezelen room promotes relaxation with dim lighting from blackout curtains and visual stimulation from bubble tubes, glowing fiber optics, projectors, and mirror balls. Auditory stimulation with constant soft tunes such as healing music is played in the room. Furthermore, olfactory stimulation is incorporated with aromas, and users can sit in comfortable postures on bead cushions or waterbeds. By experiencing various sensory stimuli, participants can enjoy their preferred sensations and spend time in a calm space. In the medical and nursing care fields, Snoezelen therapy is widely applied as a relaxation method for children with severe mental, physical, and intellectual disabilities and for patients with dementia. It helped individuals with intellectual disabilities and was reported that multisensory therapy promoted relaxation.[5] Some medical studies have also reported that Snoezelen therapy lowers participants' heart rates during rest.[6,7]

Snoezelen therapy has been broadly investigated among individuals with disabilities and older adults, and its relaxation effect has been evaluated through both behavioral observation and physiological indicators, including heart rate and saliva. However, the participants of several studies are individuals with intellectual disabilities and older adults with dementia; few studies have included healthy young individuals, including university students. Moreover, although physiological indicators such as heart rate and saliva are frequently used to determine the degree of stress, psychological scales are rarely used to determine subjective mood. Moreover, to our knowledge, there are no studies that have investigated the relationship between subjective mood and Snoezelen therapy.

Therefore, in this study, we examined the relationship between stress and the psychological conditions and the physiological relaxation effects of Snoezelen therapy among healthy students.

Materials and Methods

This prospective crossover study examined 20 healthy students (10 men and 10 women; age, 21.1 ± 1.4 years). A previous study was conducted with 20 other participants,[8] so it was determined that this was a feasible sample size for the present research period. In the present study, it was assumed that there was no excessive sleep deprivation or physical fatigue among the participants.

To recruit participants, recruitment posters were posted and distributed in multiple locations to ensure voluntary participation. The researcher explained the purpose, methods, and content of the study to willing participants and obtained written consent. This study was conducted with the approval of the Institutional Review Board of the School of Allied Health Sciences, Kitasato University (No. 2022-001).

The participants took a 15-minute Kraepelin test to induce a mental stress load, followed by a 10-minute experimental condition (Snoezelen therapy) or the control condition (rest in a separate, bright, and quiet room). We randomly assigned 5 men and 5 women to each condition so that there were 10 participants in each. Psychological (questionnaires) and physiological indices (saliva samples) were collected before and after the Kraepelin test, and after the experimental and control conditions (Figure 1). The experiment was conducted in an environment where each participant's privacy was protected and where it was easy for them to concentrate.

The experimental condition

After the Kraepelin test, the participants spent 10 minutes in a separate Snoezelen room, where we installed a bubble unit, side-glow fiber optics, a bead cushion, a projector, a mirror ball, an aroma stream, and auditory stimulation among other types of sensory stimulation (Figure 2).

The contorol condition

After the Kraepelin test, the participants rested for 10 minutes in a separate, bright and quiet room. They were asked to sit on a chair, rest quietly, and avoid using their mobile phones.

Psychological index

Profile of Mood State, 2nd Edition – Adult Short Version

The Adult Short Version of the Profile of Mood State, 2nd Edition (POMS 2-AS) was used to assess subjective mood states.[9] Seven mood scales such as anger–hostility (AH), confusion–bewilderment (CB), depression–dejection (DD), fatigue–inertia (FI), tension–anxiety (TA), vigor–activity (VA), friendliness (F), and plus total mood disturbance (TMD) were determined using standardized scores for each factor. To capture their immediate mood changes, we instructed them to answer each item about their "current" mood.

State-Trait Anxiety Inventory (STAI)

The STAI is a questionnaire designed to measure whether a participant is currently in a state of anxiety (state anxiety) and whether they are prone to anxiety

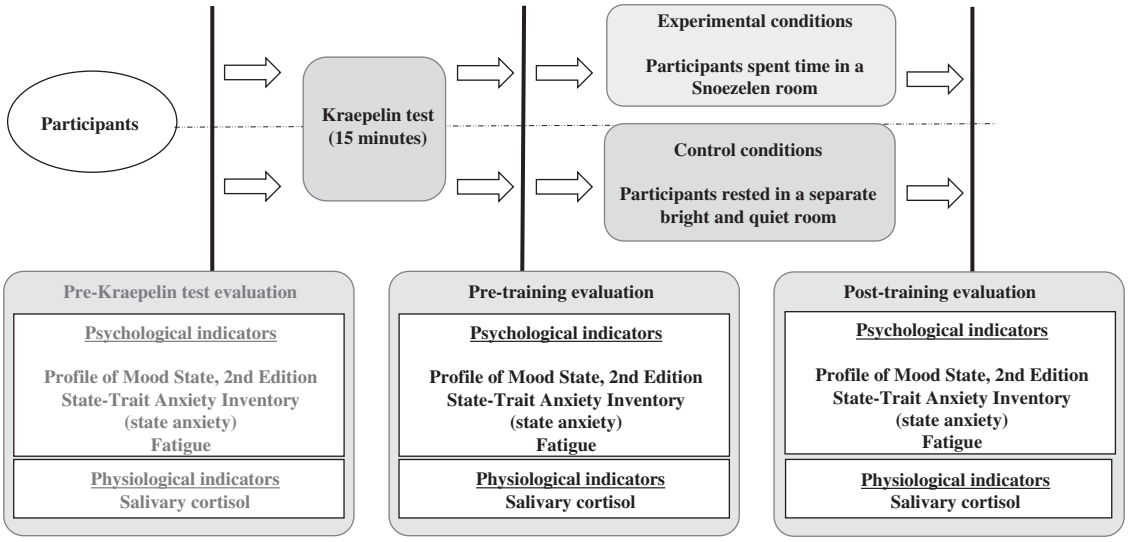

Figure 1. Experiment flow

The figure shows what was performed in 1 day as an experiment. Participants were examined for their proficiency to perform a task. Pre- and post-training evaluations were made as well as noting psychological and physiological indicators.

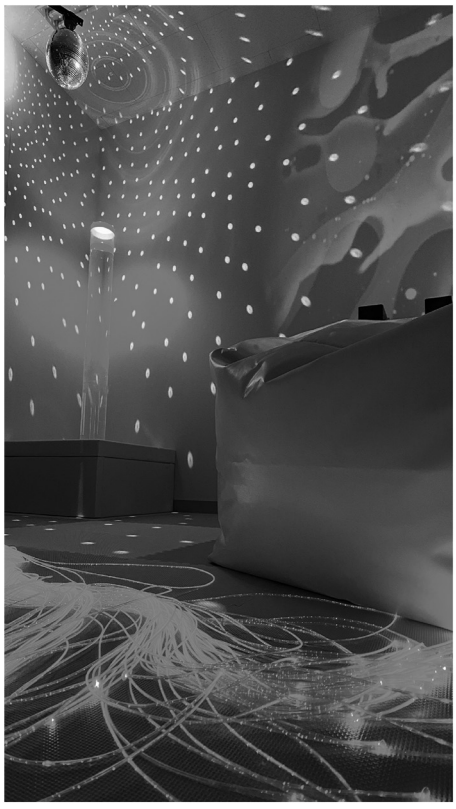

Figure 2. A Snoezelen room

The figure shows types of sensory stimulation used in the Snoezelen room, including a bubble unit, side-glow fiber optics, a bead cushion, a projector, a mirror ball, and an aroma stream (Auditory stimulation is also used.)

(trait anxiety).[10] The instrument has 40 items, 20 items for each anxiety aspect. In the present study, only state anxiety was measured.

Fatigue

Using the numerical rating scale (NRS) as a reference, each participant was asked to rate their current level of fatigue on a scale of 0–10.[11] The NRS is an objective numerical scale for measuring subjective symptoms, including pain and fatigue. In this study, the NRS was used to evaluate the subjective intensity of stress.

Physiological index

Saliva was collected from each participant, and salivary cortisol levels were calculated according to the Salimetrics manual to examine the degree of stress.[12] Twelve hours before collecting saliva, the participants were asked to limit high-sugar food, caffeine, alcohol, and nicotine (tobacco) intake, and to refrain from vigorous exercise. We asked them to eat and brush their teeth at least 1 hour before participating in the experiment.

The cortisol concentrations in the participants' saliva were measured using an enzyme-linked immunosorbent assay using the Cortisol, EIA Kit (Salimetrics; Fisher Scientific, California, USA). To account for the effects of circadian fluctuations in cortisol levels, all experimental procedures were conducted soon after 1:00 p.m. Salivary protein concentrations were also measured using a protein assay kit (BCA Protein Assay Kit; BioDynamics Laboratory, Tokyo), and the cortisol concentration per unit of salivary protein concentration was calculated.

Analysis method

Values were expressed as mean ± standard deviation. For statistical analysis, a two-factor analysis of variance with the experimental condition and time as

Flow of the experiment

Table 1. Differences between psychological and physiological indicators under experimental and control conditions

Achievements	Experimental condition (n = 20)		Control condition (n = 20)		F	
	Pre	Post	Pre	Post	Main effects of times	Interaction
POMS 2-AS						
AH	41.15 ± 2.74	38.35 ± 0.59	40.95 ± 3.62	40.00 ± 2.66	10.04**	2.44
CB	48.20 ± 8.42	42.05 ± 8.08	51.40 ± 9.72	46.55 ± 8.32	8.07**	0.11
DD	44.75 ± 7.09	42.60 ± 6.24	45.50 ± 5.91	44.10 ± 4.61	1.73	0.08
FI	45.50 ± 8.89	40.55 ± 9.40	48.85 ± 10.36	44.45 ± 9.59	4.77*	0.02
TA	44.05 ± 11.06	37.90 ± 9.54	45.15 ± 8.37	42.80 ± 8.87	3.99*	0.80
VA	49.85 ± 10.64	48.30 ± 7.79	49.50 ± 9.74	49.25 ± 9.35	0.18	0.09
F	53.90 ± 9.07	53.80 ± 9.89	54.50 ± 10.70	51.25 ± 13.60	0.47	0.41
TMD	43.90 ± 7.84	39.95 ± 7.25	46.25 ± 6.88	43.35 ± 6.71	4.55*	0.11
STAI (state anxiety)	42.20 ± 6.47	33.65 ± 6.42	41.20 ± 6.40	40.40 ± 6.65	10.40**	7.14**
Fatigue	5.90 ± 1.92	2.75 ± 1.71	5.70 ± 2.03	4.55 ± 1.85	26.15**	5.66*
Cortisol (μg/dl)	1.70 ± 0.33	1.45 ± 0.31	2.21 ± 0.40	2.08 ± 0.39	5.79*	0.61

*P < 0.05, **P < 0.01.

POMS 2-AS, Profile of Mood states, 2nd Edition–Adult Short Version; AH, anger–hostility; CB, confusion–bewilderment; DD, depression–dejection; FI, fatigue–inertia; TA, tension–anxiety; VA, vigor–activity; F, friendliness; TMD, total mood disturbance; STAI, State-Trait Anxiety Inventory

independent variables was performed to compare before and after the experimental and control conditions as well as between conditions. Furthermore, Spearman's rank correlation coefficient was used to examine the relationship between psychological and physiological indices.

All data were included in the analysis because there were no dropouts or missing data. Statistical analyses were performed using JMP17.0 (JMP Statistical Discovery LLC, Cary, NC, USA), with the significance level set at 5%.

Results

Main effect of time before and after the psychological stress load (Kraepelin test)

The POMS 2-AS items AH, CB, VA, and TMD; STAI (state anxiety); the degree of fatigue; and salivary cortisol levels showed a main effect of time before and after the Kraepelin test. The results showed that the test had the intended effect (stress effects) on the participants' stress levels: AH, $F(1, 78) = 15.30$, $P < 0.01$; CB, $F(1, 78) = 4.73$, $P < 0.05$; VA, $F(1, 78) = 4.41$, $P < 0.05$; TMD, $F(1, 78) = 4.53$, $P < 0.05$; STAI (state anxiety), $F(1, 78) = 5.36$, $P < 0.05$; fatigue, $F(1, 78) = 5.97$, $P < 0.05$; and salivary cortisol, $F(1, 78) = 4.10$, $P < 0.05$.

Main effects of time before and after Snoezelen therapy

The POMS 2-AS items AH, CB, FI, TA, and TMB; the STAI (state anxiety); the degree of fatigue; and salivary cortisol levels showed a main effect of time before and after the experimental and control conditions: AH, $F(1, 78) = 10.04$, $P < 0.01$; CB, $F(1, 78) = 8.07$, $P < 0.01$; FI, $F(1, 78) = 4.77$, $P < 0.05$; TA, $F(1, 78) = 3.99$, $P < 0.05$; TMD, $F(1, 78) = 4.55$, $P < 0.05$; STAI (state anxiety), $F(1, 78) = 10.40$, $P < 0.01$; fatigue, $F(1, 78) = 26.15$, $P < 0.01$; and salivary cortisol, $F(1, 78) = 5.79$, $P < 0.05$ (Table 1).

Interaction between the experimental conditions and time

A significant interaction was observed between STAI (state anxiety) and fatigue level under experimental conditions and time: STAI (state anxiety), $F(1, 78) = 7.14$, $P < 0.01$ and fatigue, $F(1, 78) = 5.66$, $P < 0.01$ (Table 1).

Correlations between salivary cortisol levels and psychological indicators

Salivary cortisol levels were significantly positively correlated with the POMS 2-AS items CB ($r = 0.23$; $P < 0.05$) and TA ($r = 0.27$; $P < 0.05$). The other psychological indices did not show significant correlations with salivary cortisol levels.

Discussion

Psychological changes and effects of Snoezelen multisensory stimulation

Mood stability against anxiety

In the present study, a significant interaction between the experimental condition and time was observed in STAI-induced state anxiety. This suggests that Snoezelen multisensory stimulation reduced anxiety and stabilized mood. Spielberger, who developed STAI (state anxiety), classified anxiety into trait and state anxieties and defined state anxiety as a transient feeling of anxiety.[10] Anxiety is a psychological reaction that everyone experiences as a crisis of the ego when a vague and unspecified threat is perceived in their daily lives. Transient anxiety is constantly perceived; it causes stress and physical and behavioral phenomena, including increased muscle tone, restlessness, and agitation, which interfere with daily life, when it accumulates.

In the present study, the participants' anxiety increased because of the mental load induced by the Kraepelin test; however, the anxiety was immediately significantly reduced after spending time in the Snoezelen room. This suggests that Snoezelen multisensory stimulation can reduce stress caused by anxiety, promote stable breathing, relax muscle tension, reduce irritation, and lead to a calm life.

Reduced fatigue

In the present study, a significant interaction between the experimental conditions and time was observed in the psychological indices of fatigue. In other words, the Snoezelen multisensory stimulation may have reduced the participants' fatigue, thereby leading to improved task performance in daily life. Fatigue is a characteristic discomfort, a state of diminished physical activity accompanied by a desire to rest, caused by excessive physical and mental activity or disease. When fatigue is persistent, it causes a decline in thinking ability, distraction, headaches, stiff shoulders, and other performance declines in daily life. Therefore, moderately removing fatigue accumulation is necessary.

In the present study, fatigue was caused by the mental load induced by the Kraepelin test but was immediately alleviated by spending time in the Snoezelen room. Therefore, Snoezelen multisensory stimulation may be a means to reduce accumulated fatigue and help prevent the deterioration of daily life performances.

Changes in the general mood

A significant main effect of time on the POMS 2-AS scores for both experimental and control conditions was observed. This result suggests that after the Kraepelin test, which imposed a mental load, providing a certain amount of rest time, regardless of the content of the rest, leads to a certain degree of mood stabilization. Similarly, a previous study reported that participants stabilized their mood when they took slow static rests and paid attention to their breathing in a room with no bright lights or noise.[13]

However, no significant interaction was noted between the experimental conditions and time for the POMS 2-AS. One possible reason for this is that the immediate effects of the Snoezelen room could not be measured because of the characteristics of the POMS 2-AS as an evaluation scale. As the POMS 2-AS is a self-reported scorecard intended to evaluate overall moods and emotions, it is inadequate to measure the limited emotional changes caused by the fluctuating stress response system during Snoezelen therapy. Specifically, some POMS 2-AS question items are unlikely to change because of temporary feelings, including "I am a worthless person," "I have no hope," "I trust others," and "I want to be kind to others."

Effects of Snoezelen multisensory stimulation on the brain

In this study, the experimental condition following mental stress reduced anxiety and fatigue more than did the control condition. Multisensory stimulation acts on the brain to reduce stress and improve mental performance. Mental stress is transmitted to the hypothalamus via the cerebral cortex and limbic system, and subsequently the stress response system, the "hypothalamus–sympathetic nerve–adrenal medulla system (SAM system)," and the "hypothalamus–anterior pituitary–adrenal cortex system (HPA system)" works. These systems affect various biological functions and emotions when activated, thereby causing increased blood pressure, blood sugar, cardiac contractility, and cardiac output.[14] Therefore, attenuating these functions is significant to relieve mental stress.

Salivary cortisol levels were used as a stress response index. Cortisol is a major glucocorticoid secreted from the adrenal cortex. It has physiologically important functions, including blood sugar regulation, and is used as an HPA system activation biomarker. Cortisol is secreted into the saliva, and studies have demonstrated a high correlation between salivary and blood cortisol levels. A study by Kudielka et al.[15] using salivary cortisol

showed that cortisol levels temporarily increase in short-term stress situations, such as during mental arithmetic calculations, Stroop tasks, oral presentations, and interviews. Therefore, salivary cortisol is a promising short-term stress marker.[15]

In the present study, the participants felt stressed and showed increased cortisol concentrations after a mental stress load induced by the Kraepelin test. However, no significant interaction was observed between the experimental conditions and salivary cortisol concentrations. This may be because of differences in the cortisol reaction mechanisms, reaction speeds, and degrees of stress. The SAM and HPA systems are activated when a person experiences stress. Cortisol reflects HPA system activation, and norepinephrine controls the SAM system. When individuals are stressed, their sympathetic nervous system is excited, which activates the SAM system. This system acts on β-adrenergic receptors in salivary glands, which secrete α-amylase.[14,16] Amylase has also been correlated with the STAI (state anxiety).[17]

A significant positive correlation was observed between salivary cortisol levels and the POMS 2-AS items CB and TA; however, salivary cortisol levels showed no other correlations with psychological indicators. As in previous studies, salivary cortisol concentrations were correlated with POMS, increased with negative emotions and stress, and decreased with positive emotions.[18]

From these results, Snoezelen therapy seems to reflect the action of the SAM system rather than that of the HPA system. Furthermore, it has been reported that the increase in cortisol levels due to short-term stress is accompanied by a time delay from the onset of the stress event, and that it takes more than 60 minutes for the cortisol concentration to return to the original level.[19] Therefore, the cortisol response was likely delayed due to the limited time spent in the Snoezelen room. However, these physiological indicators require further study.

Among the effects of Snoezelen therapy is relaxation. The use of sensory stimulation devices activates brain functions through primitive sensory stimulation. Snoezelen therapy acts on the nervous system. According to Mertens[20] and Anesaki,[21] several aspects of cerebral functions have not yet been clarified; however, the Snoezelen environment mainly activates the limbic system, which controls emotions and behavior. Because the Snoezelen multisensory environment causes a relaxation effect, it may encourage alpha wave production, thereby leading to a sense of well-being. Moreover, research on perceptual psychology reported that multisensory environments produce greater activity in certain brain areas than a single sensory stimulus.[20] Moreover, in this study, the parts of the limbic system related to sight, hearing, smell, and touch were activated by the Snoezelen environment following the mental stress induced by the Kraepelin test and promoted alpha wave generation. Controlling the stress reaction system may have calmed the participants. Based on the understanding of cerebral blood flow and other physiological mechanisms, our future research will endeavor to clarify how the Snoezelen environment acts on the brain.

Applications and usefulness of this study

This study suggests that Snoezelen multisensory stimulation reduces mental stress in healthy participants. The Snoezelen therapy is particularly useful for the psychological aspects of anxiety and fatigue and may be a means to prevent declines in daily performance and help individuals lead calmer lives.

Considering these results, multisensory stimulation environments, especially Snoezelen rooms, are beneficial not only for individuals with disabilities and older adults but also for healthy young individuals as well. This suggests that Snoezelen activities can be used for self-care to control one's health and to enhance emotional stability for healthy individuals in a stressful society.

Research limitations

This study has some limitations. First, the immediate effects of the Snoezelen environment were not determined because of the short study period, and long-term psychological effects remain unknown. Furthermore, we learned that the Snoezelen environment affects the autonomic nervous system function; however, these results did not elucidate the mechanism. Future studies are warranted that will include larger study populations, examine the long-term effects of Snoezelen therapy, and examine the mechanism of the Snoezelen therapy's effect on the function of the autonomic nervous system.

Conclusion

To clarify the psychological changes caused by Snoezelen multisensory stimulation, the Kraepelin test was used to induce a mental stress load on the participants who were then allowed to rest in a separate, bright, and quiet room or experience a brief time in a Snoezelen room. We observed that Snoezelen

multisensory stimulation immediately led to mood stabilization of anxiety and reduced fatigue. In other words, multisensory stimulation suppressed the sympathetic nerve activity of the autonomic nervous system. This function reduces the irritation caused by anxiety and accumulated fatigue, potentially leading to a calmer daily life and improved performance.

Conflicts of Interest: None

References

1. Sakai N. Effects of chemical senses on easing mental stress induced by solving puzzles. *Jpn J Res Emot* 2009; 17: 112–9 (in Japanese).
2. Sato S, Watanabe S, Yanamoto K, et al. Effect of auditory and olfactory stimulation on prefrontal cortex for stress alleviation. *Stud Sci Tech* 2017; 6: 25–30.
3. Iwasaki H, Yamamoto S, Gon K, et al. Experimental research on effect of stress easing which existence of plant in the indoor space. *J Jpn Soc Reveg Tech* 2006; 32: 247–9 (in Japanese).
4. Anesaki H. Snoezelen education: significance and development of its introduction to special needs schools in Japan. *Jpn J Spce Educ* 2013; 51: 369–79 (in Japanese).
5. Slevin E, McClelland A. Multisensory environments: are they therapeutic? a single-subject evaluation of the clinical effectiveness of a multisensory environment. *J Clin Nurs* 1999; 8: 48–56.
6. Baillon S, Diepen EV, Prettyman R. Multi-sensory therapy in psychiatric care. *Adv Psychiatr Treat* 2002; 8: 444–52.
7. Heyn P. The effect of a multisensory exercise program on engagement, behavior, and selected physiological indexes in persons with dementia. *Am J Alzheimers Dis Other Demen* 2003; 18: 247–51.
8. Takahashi K, Suzuki M, Oguchi Y, et al. An experimental study on the appropriateness of work forms in occupational therapy: psychological and physiological effects of giving work activities a purpose. *Occup Ther* 2004; 23: 630 (in Japanese).
9. Lorr M, McNair DM, Heuchert JWP, et al. *Profile of mood states – brief Japanese version*, Muliti Health Systems Inc; 1971.
10. Spielberger CD, Gorsuch RL, Lushene RE. STAI manual, Consulting Psychologists Press; Palo Alto, CA; 1970.
11. Linton SJ, Coestam GK. A clinical comparison of two pain scales: correlation, remembering chronic pain, and a measure of compliance. *Pain* 1983; 17: 57–65.
12. Salivary Cortisol ELISA Kit. *Assay Protocol*. Available at: https://salimetrics.com/assay-kit/salivary-cortisol-elisa-kit/. Accessed November 1, 2022.
13. Midori H, Hajime Y. The influences of noises in performing tasks and the effects of breath control techniques: study of psychology. *Health Psychol Clin Psychol* 2013; 3: 23–37.
14. Izawa S, Shirotsuka K, Sugiya N, et al. The application of saliva to an assessment of stress: procedures for collecting and analyzing saliva and characteristics of salivary substances. *Jpn J Comp Alter Med* 2007; 4: 91–101 (in Japanese).
15. Kudielka BM, Buske-Kirschbaum A, Hellhammer DH, et al. HPA axis responses to laboratory psychosocial stress in healthy elderly adults, younger adults, and children: impact of age and gender. *Psychoneuroendocrinology* 2004; 29: 83–98.
16. Nater UM, La Marca R, Florin L, et al. Stress-induced changes in human salivary alpha-amylase activity--associations with adrenergic activity. *Psychoneuroendocrinology*. 2006; 31: 49–58.
17. Murakami M, Tahara Y, Takeda K, et al. Psychosomatic stress and salivary amylase activity in junior high school student. *Trans Jpn Soc Med Bio Eng* 2009; 47: 166–71 (in Japanese).
18. Kawano A, Emori Y, Miyagawa S. The relationship between postpartum mother's psychological state by POMS (Profile of Mood States) and saliva SIgA and cortisol concentrations. *J Jpn Acad Midwife* 2008; 22: 17–24 (in Japanese).
19. Dickerson SS, Kemeny ME. Acute stressors and cortisol responses: a theoretical integration and synthesis of laboratory research. *Psychol Bull* 2004; 130: 335–91.
20. Mertens K. *Snoezelen: Eine Einführung in die Praxis*. Dortmund: Modernes Lernen Verlag; 2003.
21. Anesaki H. Investigation research on teaching theory/technique and teaching contents of “jiritsu-katsudo” required of children with severe motor and intellectual disabilities: based on a national survey of special needs schools for children with physical disabilities. *J Sci School* 2012; 63: 297–314.