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Effects of music and art education in early life and oral functions on the QOL of Takarazuka Revue Company OG, comparing to the general elderly females, including relationships with changes in brain morphology.

宝塚歌劇団 OG と一般女性高齢者を対象とした若年期の音楽・芸術教育及び口腔機能が QOL に及ぼす影響——脳の形態学的変化との関連性も含めて

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Key words

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Effects of music and art education in early life and oral functions on the QOL of Takarazuka Revue Company OG, comparing to the general elderly females, including relationships with changes in brain morphology.

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Abstract

Background: Today, Japan is becoming a Super-Aged Society, with senior citizens already constituting over 21% of the population. In this situation, the question of how elderly people can extend their lives and enjoy independent lifestyles is becoming more important. This study aims to clarify the relationship between the Quality of Life (QOL) of elderly females and their current oral functions and experiences of music and art education in early life.

Method: We conducted a survey study focusing on elderly females (Takarazuka Revue Company OG group and general female group) by conducting a questionnaire survey and comparing cognitive function, oral examinations, cerebral atrophy in MRI, and other characteristics.

Results: It was shown that the Takarazuka Revue Company OG group had greater hippocampal volumes and significantly higher cognitive functions than the general female group. In addition, in the general female group, there was a significant correlation between decreases in the number of remaining teeth and decreases in Activities in Daily Living (ADL), but in the Takarazuka Revue Company OG group, no such correlation was observed.

Conclusions: The results showed that those who have received art education as part of their careers over an extensive period since early life have higher levels of cognitive function, QOL, physical activity, social activity, and life satisfaction compared to the general female group, indicating that they sense a purpose in life and live with a positive attitude. On the other hand, in the general female group, those who have continued to enjoy hobbies have higher levels of cognitive function, QOL, physical activity, social activity, and life satisfaction than those who have not, thus indicating that they live with a positive attitude.

Key words

Elderly female, music and art education, QOL, MMSE, oral examination, MRI

INTRODUCTION

As of 2009, in the demographic composition of Japan, the young population (ages 0-14) constitutes 13.5%, the producing population (ages 15-64) constitutes 64.1%, the elderly population (ages 65 and older) constitutes 22.4%, and the population of persons aged 75 and older constitutes 10.5%¹. This trend is expected to reach a peak in 30 years in 2040, when the elderly population is expected to exceed 36%². Furthermore, the current percentage of elderly males and females relative to the overall population is 19.6% for males and 25.1% for females, and within the population of those aged 75 and older, 8.2% are males and 12.8% are females, which shows that females overwhelmingly enjoy longer lives¹. Moreover, the average life expectancy for Japanese females has exceeded the age of 86, which has been the highest life expectancy in the world for 24 consecutive years³. In Japanese society, one critical issue is how elderly females can enjoy a purpose in life and enjoy their lives with “health” as defined by the WHO; that is, free from not only physical and mental handicaps but also social inconveniences. It is said that differences in an individual’s positive attitude toward their own lifestyle, life history, social activities, and other factors greatly affect their “health”. In addition, among elderly people, the recovery of oral functions, such as occlusion and dentition, is an important factor for not only ensuring energy for activities

but also inhibiting deteriorations in general bodily functions, such as brain functions, and ensuring Quality of Life (QOL), which includes factors such as longevity, independence, and purpose in life⁴⁻⁷. Additionally, higher masticatory satisfaction is correlated with higher levels of subjective happiness, better health practices, and higher levels of physical activity^{8,9}. Furthermore, it has been reported that a lack of teeth and reductions in occlusal force are correlated with decreases in QOL¹⁰⁻¹², while music and art are related to improvements in QOL and brain activity^{13,14}. However, there are many aspects that are not yet fully understood.

This purpose of study is to survey the effects of oral functions, which are closely associated with food intake for health and the acquisition of energy for activities, on cognitive function, levels of depression, life satisfaction, masticatory satisfaction, and changes in brain morphology caused by aging, including relationships with music and art education in early life, in order to extract environmental factors from these results for elderly females to live with physical and mental health and with a purpose in life.

The present study has been approved by the Medical Ethics Committee of the Kobe University Graduate School of Medicine.

Participants provided informed consent in accordance with the provisions of the Declaration of Helsinki.

SUBJECTS AND METHODS

1 Subjects

The subjects comprised individuals from the Takarazuka Revue Company Hoyu-kai (Takarazuka Revue Company OG Association), Yu-no-kai (volunteer association), and other individuals referred to use by several dentists.

Survey 1

We conducted a questionnaire survey of 230 (the Takarazuka Revue Company OG group 126 : the general female group 104) subjects who agreed to cooperate. (Table 1). There were no significant differences in mean age between the Takarazuka Revue Company OG group and the general female group.

Survey 2

We conducted neuropsychological tests and oral examinations of 124 (OG group 62 : control group 62) subjects who agreed to cooperate. There were no significant differences in mean age between the OG group and the control group. We investigated as many relationships as possible based on the results of each survey and oral examination with regard to each of the following groups: within the Takarazuka Revue Company OG group, a group of subjects with entertainment careers of 10 years or more (OG group A) and a group of subjects with

entertainment careers of less than 10 years (OG group B); and within the general female group, a group of subjects with experience in cultural activities (control group A) and a group of subjects with no experience in cultural activities (control group B). We also conducted similar investigations based on the analysis results of each of the following groups: within the OG group, a group of subjects who have continued artistic activities and a group of subjects who have not continued artistic activities; and within the control group, a group of subjects who have continued to participate in cultural activities and a group of subjects who have not continued participating in cultural activities (Table 2).

Survey 3

We conducted MRI examinations of 31 (OG group 16 : control group 15) randomly selected subjects from Survey 2. The breakdown is shown in Table 3. There were no significant differences in mean age between the OG group and the control group.

2 Methods

Survey 1

We conducted statistical analyses for as many relationships as possible from the results of the questionnaire survey regarding each of the following items:

“forgetfulness” and “sickliness and health during childhood” in Survey 1.

Survey 2

Mini Mental State Examination (MMSE), which is a cognitive function test, in Survey 2; Geriatric Depression Scale (GDS), which is a self-rating depression scale; ADL, or activities of daily living; QOL, or quality of life/purpose in life; Life Satisfaction Index (LSI), which is an index of life satisfaction; Health Practice Index (HPI), which is an index of health practices; and masticatory satisfaction⁹, as well as from the survey results regarding occlusal force and the number of remaining teeth (right and left anterior teeth, posterior teeth) obtained from the oral examinations, for each subject.

1) The levels of cognitive function and depression were determined using neuropsychological tests (MMSE and GDS).

2) Oral examination

(a) Occlusal conditions and prosthetic status of the subjects.

We examined the number of remaining teeth, the number of prosthetic restorations in defective sites, the use or non-use of removable dentures, and the masticatory satisfaction index.

(b) Occlusal force test

Occlusal force was measured using a handy-type occlusal force meter (GM10 occlusal force meter manufactured by Morita Corporation).

3) QOL and ADL⁹

(a) QOL

QOL was surveyed using Lawton's PGC Morale Scale. In addition, LSI and HPI were also surveyed.

(b) ADL

Physical activity, social activity, and other factors were surveyed.

Survey 3

We further compared the degree of cerebral atrophy using the head MRI images of several subjects.

1) Brain MRI Imaging

Among the subjects who had an MMSE score of 24 points or higher, the hippocampal volumes of 31 subjects who agreed to undergo an MRI examination (OG group: 16 subjects; control group: 15 subjects; Table 3) were compared using the following means.

These 31 subjects do not have organic brain disorders.

2)MRI Scanning

All imaging was performed on an MR system operating at a field strength of 3.0 T (Philips Medical Systems, Best, The Netherlands). Axial T2-weighted images (repetition time [TR] = 3,500 ms; echo time [TE] = 120 ms; flip angle = 90°; slice thickness = 5 mm; FOV = 230 mm; matrix = 512 × 512), axial fluid-attenuated inversion recovery (FLAIR) images (delay time [TI] = 2,800 ms; TR = 11,000 ms; TE = 125 ms; flip angle = 90°; slice thickness = 5 mm; FOV = 230 mm; matrix = 512 × 512), and sagittal T1-weighted turbo field echo (T1-TFE) images (TR = 7.6 ms; TE = 4.3 ms; flip angle = 8°; slice thickness = 0.9 mm; FOV = 230 mm; matrix = 512 × 512).

3)MRI Analysis

Brain atrophy and the hippocampal volumes were determined offline after the images were transferred to a workstation for analysis, and were obtained using the image processing software QBrain[®] (version 1.1.14.0, Medis Medical Imaging Systems Inc., Leiden, The Netherlands). For the assessment of brain atrophy, segmentation of intracranial volume and brain parenchyma volume was performed automatically using a combination T2-weighted and FLAIR images from each subject. A measure reflecting atrophy was calculated using the equation: atrophy (%) = [(intracranial volume - parenchymal volume)/intracranial volume] × 100%.¹ For

measure of hippocampal volume, bilateral hippocampi were manually outlined in each slice on T1-TFE which has quality in gray matter-white matter contrast, and these volumes were determined by multiplying the area by the slice thickness. Each hippocampal volume was corrected for parenchyma volume. All measurements were performed blinded to subject identity and age.

Representative slices are shown. T1-weighted turbo field echo image at 3T clearly indicates the hippocampal areas due to its high spatial resolution. On sagittal images hippocampal areas were manually drawn and hippocampal volume was determined by multiplying the areas by the slice thickness.

3 Statistical processing

Data are represented by mean and standard deviation (SD).

For statistical processing, Student's *t*-test and the chi-square tests were used for comparisons between two groups. In addition, one-way analysis of variance was used for comparisons between 3 groups or more by dividing the groups, and Tukey's method was used for multiple comparisons. Additionally, Pearson's correlation coefficient was used for discussing the relationships between each parameter. The significance level was 5%.

RESULTS

Survey 1

1) Forgetfulness

The proportion of subjects who answered “I am forgetful” was significantly higher in the overall control group in comparison to the overall OG group ($P < 0.05$) (Table 4).

2) Sickliness and health in childhood

There were no significant differences between the overall OG group and the overall control group in the proportion of subjects who answered that they had been sickly during childhood and the proportion of subjects who answered that they had been healthy during childhood (Table 4).

Survey 2

1) MMSE

In a comparison of the overall OG group and the overall control group, there were no significant differences in the MMSE values, but when the OG group A (26.8 ± 2.0) and the overall control group (25.2 ± 3.3) were compared, the MMSE score was clearly higher in the former group ($P < 0.01$) (Fig. 1 (A)), and when the OG group A (26.80 ± 2.04) and the control group B (24.57 ± 3.12) were compared,

the MMSE score was significantly lower in the latter group ($P < 0.01$). In addition, in the overall OG group, the subjects who stopped participating in artistic activities at an older age had higher MMSE scores ($r = 0.32$, $P < 0.05$), and in a comparison between the OG group A and the OG group B, it was observed that the proportion of subjects with low MMSE scores (26 points or lower) was significantly lower in the latter group ($P < 0.01$). Moreover, in the overall OG group, there were no significant differences in MMSE score between subjects who have continued artistic activities and those who have not continued artistic activities.

2) GDS

In a comparison of the OG group A (2.4 ± 2.1) and the overall control group, (3.7 ± 2.8) the GDS scores were significantly higher in the latter group ($P < 0.05$) (Fig. 1 (B)), and when subjects in the overall OG group who have continued artistic activities (2.00 ± 2.18) were compared with subjects in the control group who have not continued participating in cultural activities (3.98 ± 2.77), the GDS scores were significantly higher in the latter ($P < 0.05$). Furthermore, in a comparison of the OG group A (2.40 ± 2.14) and the control group B (4.30 ± 2.88), the GDS scores were significantly higher in the latter group ($P < 0.05$), and in the

overall control group, the GDS scores were significantly lower ($P < 0.001$) among the subjects who have continued to participate in cultural activities (1.14 ± 1.35) in comparison to the subjects who have not continued to participate in cultural activities (3.98 ± 2.77). Moreover, in the overall OG group, no differences in GDS scores were observed between subjects who had continued artistic activities and subjects who had not continued artistic activities.

3) QOL

In a comparison of the OG group A (11.80 ± 3.49) and the control group B (9.74 ± 3.71), the QOL tended to be higher in the former group ($P = 0.053$). In addition, in the overall control group, the QOL of the subjects who had continued to participate in cultural activities (13.57 ± 3.26) was significantly higher ($P < 0.05$) in comparison to the subjects who had not continued to participate in cultural activities (10.67 ± 3.37), and no differences in QOL were observed between the subjects who had continued artistic activities and the subjects who had not continued artistic activities in the OG group.

4) LSI

Significant differences were observed between the overall OG group ($10.92 \pm$

3.96) and the overall control group (9.26 ± 3.98), and the LSI was higher in the former group ($P < 0.05$). In addition, in a comparison of the OG group A (11.44 ± 3.72) and the overall control group, the LSI was significantly higher in the former group ($P < 0.05$), and furthermore, in a comparison of the OG group A and the control group B (8.22 ± 3.54), the LSI was significantly higher in the former group ($P < 0.01$). In addition, in the overall OG group, no differences in LSI were observed between subjects who have continued artistic activities and subjects who have not continued artistic activities.

5) Masticatory satisfaction

The age when the subjects stopped artistic activities was significantly correlated with masticatory satisfaction in the overall OG group ($r = 0.28$, $P < 0.05$). There were no differences in the masticatory satisfaction between the subjects who had continued artistic activities and the subjects who had not continued artistic activities. On the other hand, in the overall control group, there was a tendency in which masticatory satisfaction was higher among the subjects who had continued to participate in cultural activities in comparison to the subjects who had not continued to participate in cultural activities ($P = 0.09$).

6) Relationship between the number of remaining teeth and other factors

With regard to the number of remaining teeth, no significant differences were observed in the number of remaining right and left anterior teeth and posterior teeth between the overall OG group and the overall control group.

(a) Age and occlusal force

In both the overall OG group and the overall control group, the number of remaining teeth decreased as the subjects grew older for both right and left anterior teeth and posterior teeth, including the right anterior teeth ($r = -0.29$, $P < 0.01$), left anterior teeth ($r = -0.25$, $P < 0.01$), right posterior teeth ($r = -0.34$, $P < 0.001$), and left posterior teeth ($r = -0.27$, $P < 0.01$). In the overall OG group, the number of remaining right posterior teeth was significantly correlated with age ($r = -0.89$, $P < 0.01$), and a similar tendency was also observed in the left posterior teeth ($r = -0.24$, $P = 0.06$). At the same time, in the overall control group, the number of remaining right posterior teeth ($r = -0.33$, $P < 0.01$), right and left anterior teeth ($r = -0.39$, $P < 0.01$; same value for both the right and left sides), and left posterior teeth ($r = -0.32$, $P < 0.05$) was clearly related to aging. In addition, with regard to the occlusal force, no significant differences were observed between the overall OG group and the overall control group. Moreover, occlusal force was strong if, with regard to right occlusal force, there were

higher numbers of right anterior teeth ($r = 0.45$, $P < 0.001$), left anterior teeth ($r = 0.42$, $P < 0.001$), right posterior teeth ($r = 0.57$, $P < 0.001$), and left posterior teeth ($r = 0.55$, $P < 0.001$) and, with regard to left occlusal force, if there were higher numbers of right anterior teeth ($r = 0.50$, $P < 0.001$), left anterior teeth ($r = 0.48$, $P < 0.001$), right posterior teeth ($r = 0.57$, $P < 0.001$), and left posterior teeth ($r = 0.59$, $P < 0.001$).

(b) GDS

In both the overall OG group and the overall control group, the GDS scores were significantly low when there were high numbers of right anterior teeth ($r = -0.18$, $P < 0.05$) or left anterior teeth ($r = -0.19$, $P < 0.05$). In addition, in the overall OG group, the number of remaining left right anterior teeth was not correlated with the GDS scores, while in the overall control group, the number of remaining right anterior teeth ($r = -0.26$, $P < 0.05$) was significantly correlated with the GDS values, and a similar tendency was also observed in the left anterior teeth ($r = -0.25$, $P = 0.05$).

(c) MMSE

In both the overall OG group and the overall control group, no correlations

were observed between the number of remaining teeth and MMSE scores.

(d) ADL

In both the overall OG group and the overall control group, higher numbers of remaining right posterior teeth ($r = 0.24$, $P < 0.01$), right anterior teeth ($r = 0.26$, $P < 0.01$), left anterior teeth ($r = 0.28$, $P < 0.01$), and left posterior teeth ($r = 0.19$, $P < 0.05$) were correlated with significantly higher levels of ADL. Moreover, in the overall control group, the number of remaining right anterior teeth ($r = 0.48$, $P < 0.001$), right posterior teeth ($r = 0.41$, $P < 0.001$), and left posterior teeth ($r = 0.37$, $P < 0.01$) was correlated with ADL, but in the overall OG group, there was no correlation between ADL and any of the numbers of remaining teeth. Furthermore, with regard to the relationship between ADL and the number of remaining posterior teeth on both sides and between ADL and the number of remaining anterior teeth on both sides, correlations were observed in both relationships in the overall control group, while no such correlations were observed in the overall OG group (Fig. 2).

(e) QOL, HPI, and masticatory satisfaction

In both the overall OG group and the overall control group, the QOL was significantly higher ($r = 0.18$, $P < 0.05$) with higher numbers of right anterior

teeth, and there was a tendency in which the QOL was higher ($r = 0.15$, $P = 0.09$) with higher numbers of left anterior teeth. Moreover, in the overall control group, there was a tendency in which the HPI also increased ($r = 0.21$, $P < 0.10$) with higher numbers of remaining right anterior teeth, while in the overall OG group, but no correlation was observed between the number of remaining anterior teeth and the HPI.

With regard to masticatory satisfaction, in both the overall OG group and the overall control group, higher numbers of the left and right anterior teeth ($r = 0.24$, $P < 0.01$), right posterior teeth ($r = 0.28$, $P < 0.01$), and left posterior teeth ($r = 0.23$, $P < 0.05$) were correlated with significantly higher levels of masticatory satisfaction. In addition, in the overall OG group, the number of remaining left and right posterior teeth ($P < 0.05$) was significantly correlated with masticatory satisfaction. At the same time, in the overall control group, the number of remaining right anterior teeth ($r = 0.29$, $P < 0.05$), left anterior teeth ($r = 0.32$, $P < 0.05$), and right posterior teeth ($r = 0.30$, $P < 0.05$) was significantly correlated with masticatory satisfaction.

Survey 3

MRI examination

The analysis results are shown in Fig. 3.

Regarding the hippocampal volume, significant differences between the two groups were observed for both the right and left sides, and the OG group had significantly higher volumes compared to the control group ($P < 0.01$). Furthermore, the same result was obtained when the hippocampal volumes per 1,000 ml of brain volume were compared ($P < 0.05$).

Regarding age, MMSE, GDS, intracranial volume, brain volume, and rate of cerebral atrophy, no significant differences were observed between the two groups.

DISCUSSIONS

Due to continuing medical progress, improvements in the nutritional status, and other factors, the average life expectancy among Japanese people has increased rapidly and Japan has become the world's highest ranking country in terms of life expectancy, and with an average life expectancy of 86.05 years old³ for females, healthy life expectancy is now becoming a big issue. In order to create a rich society of longevity, it is vital to extend healthy life expectancy so that people can live healthily and independently.

In order to actualize healthy longevity, even more than the mental and social environments of elderly people, it is important to maintain and restore past lifestyle habits as well as dietary habits necessary for maintaining health and the oral function that support such habits for all elderly people. In the present study, in addition to these aspects, we analyzed the effects of experiences in receiving professional art education, the duration of such education, and the subsequent continuance thereof as well as the presence or absence of artistic experience as a hobby on the level of independence, QOL, cognitive function, degree of depression, and level of daily activity of individual elderly people and on the functional state of the oral cavity, morphological changes in the brain, and other characteristics.

In a comparison of the subjects in the OG group with entertainment careers of 10 years or more with subjects in the overall general female group, the MMSE values were significantly higher in the former group. It is believed that one of the causal factors is that from early life, the subjects of the former group had been educated to learn ballet and music by heart within short periods of time through art education and had to attract the audiences in their own expressive styles. As stage plays are an instantaneous art, we believe that concentration was also cultivated. In addition, it was found that within the OG group, individuals who had received art education for over 10 years had higher MMSE values than subjects with less than 10 years of art education, and the MMSE values were also high for subjects who stopped art activities at a later age. In addition, based on the fact that no significant differences were recognized in other items including MMSE values between individuals who are still continuing art activities and subjects who are not, it was clarified that receiving 10 or more years of art education in early life was one of the major factors for preventing decreases in the cognitive function.

The results of this study show that subjects who received art education for a prolonged

period from early life tended to have better results regarding their cognitive function, physical activity, social activity, and life satisfaction in comparison to general females, thus suggesting that they are able to find a purpose of life in this aging society and are living with a positive attitude. On the other hand, in the control group, the GDS scores were significantly lower and the QOL and masticatory satisfaction was higher among individuals who have continued their hobbies compared to subjects who have not, and based on these results, it was assumed that the subjects of the former group were therefore living with a positive attitude.

It was further revealed that the LSI values were notably higher in the overall OG group compared to the overall general female group, and furthermore, within the overall OG group, individuals who had an entertainment career of 10 or more years had significantly higher LSI values than general female subjects with no experience in cultural activities. According to these results, it is assumed that individuals who have received education for stage art from early life had felt a sense of achievement and happiness in overcoming difficulties when they demonstrated the results of their daily practice in front of audiences, and they came to know the pleasure borne from hardship. In particular, it is believed that subjects with entertainment careers of 10 or more years

store a sufficient sense of achievement and happiness from appearing on stage into their memories. However, as shown from the results of the questionnaire Survey 1, most of these subjects have been living as homemakers in much the same way as the general females, and the period of art education in early life before the age when they stopped receiving art education was the only term when they spent time in a different manner from general females. From these facts, we believe that subjects who have received art education for an extensive period from early life have made a life habit of finding happiness and joy even in daily life and are living their lives positively.

Regarding the QOL and purpose of life, in comparisons of the subjects in the OG group with entertainment careers of 10 or more years and subjects in the control group with no experience of cultural activities, the QOL was higher in the former group. On the other hand, it was also indicated that for subjects in the control group, the continuation of cultural activities late in life affects improvements in QOL.

In addition, regarding relationships between the number of remaining teeth and GDS scores, it can be said that in the control group, the lack of right anterior teeth was significantly correlated with increases in GDS scores and the lack of left anterior teeth

tended to increase GDS scores. At the same time, in the overall OG group, it was also clarified that the number of remaining anterior teeth was not associated with the GDS scores. Considering the difference between these two groups, the anterior teeth are generally an important factor that affect the beauty of an individual's facial appearance and are a major aesthetic factor, especially for females. Individual may feel a sense of psychological inferiority due to the lack of anterior teeth, which is believed to lead to a sense of psychological "melancholy." Particularly for general females, it is also possible that they have become unable to bring themselves to leave the sidelines due to the aforementioned issue, leading to a form of social withdrawal, which is assumed to lead to "melancholy." On the other hand, although it is possible for subjects in the OG group to fall into a similar mind state, due to the education and discipline that they received to go on stage and place themselves at the forefront, they may seem to have a mentality of emphasizing the physical and facial beauty; therefore, aesthetic restoration and sufficient care are provided for defective conditions and are believed to develop a normal state with an absence of feelings of psychological inferiority. We therefore believe there was no correlation between the number of remaining anterior teeth and depression for this reason.

In the control group, there was a marked correlation between the number of remaining left and right anterior and posterior teeth and ADL. On the other hand, in the OG group, it was found that there was no correlation between the number of remaining teeth and ADL. Considering the difference between these two groups, it is believed that individuals in the OG group, who have received strict art education as a profession from early life, build up robust legs and waists through ballet, classical Japanese dance, etc., have a daily habit of walking with a proper posture, strongly care about dietary life and health, actively enjoy communication with friends, maintain interest in newspaper and magazine articles, and maintain an active state both physically and psychologically. We believe that as a result of implementing sufficient supplemental procedures for defects, which are important for daily conversations and dietary life, no correlation was observed between the number of remaining teeth and the physical and social activities constituting ADL. Although there are reports in which significant positive correlations were observed between the number of remaining teeth and the physical and social activities constituting ADL^{8,9}, similar outcomes were obtained for the control group from the results of this study.

Although there are also some reports in which a positive correlation was observed

between the number of remaining teeth and the MMSE/ADL of elderly people^{5,15}, it has been found that a lack of teeth decreases chewing ability and cognition, which thus become a cause of decreased independence^{10,16,17}. Accordingly, it is apparent that daily oral care and supplemental restoration of defective areas in teeth alignment play an important role that is necessary for obtaining health and a purpose of life and leading an independent life in a society of longevity¹⁸⁻²⁰. Based on the above findings, in the present study, we clarified how art education affects individuals in later life.

Recently, there have been several reports on the effects of music and art therapy on increases in QOL and ADL for elderly people^{13,14}. However, there have been no reports other than the present study indicating that professional music and art education in early life can be a factor for maintaining cognition in later life and improving the quality of life and purpose of life, the level of life activity, etc. Conventionally, it is said that music and art education are relative to scientific states, and it is difficult to prove scientifically. However, from this research and study on the effects on the later life of receiving music and art education for a certain period of time in early life, it was found that professional music and art education controlled decreases in cognitive functions from a medical perspective and also affected levels of physical activity and social activity.

The periphery of the hippocampal area is an area that has been drawing attention as an area of the brain that expresses structural changes (i.e., atrophy) from the earliest stages from among cerebral degenerations associated with Alzheimer's disease (AD)^{21,22}, and there are several reports that support the conclusion that a relationship between hippocampal atrophy and decline in the cognitive function exist based on the findings of MRI²³. First, regarding the relationship between the hippocampal volume and decline in cognitive function in cases of Mild Cognitive Impairment (MCI) and AD, some reports have described that significantly higher levels of brain atrophy was observed in several areas of the brain, including the hippocampus, in cases of MCI^{24, 25} and cases of AD^{24,26} compared to healthy subjects. In addition, other reports have stated that higher degrees of advancement of hippocampal atrophy are expressed in AD, MCI, and healthy subjects in that order and that this advancement is correlated with the first MMSE score and subsequent temporal changes²⁷. Furthermore, another report states that hippocampal atrophy advances more rapidly in healthy subjects with ApoE4 compared to subjects without ApoE4 and that hippocampal atrophy advanced more rapidly in cases transitioning from MCI to AD in comparison to non-transitioning cases²⁷. At the same time, it has been reported that in cases of AD and MCI and in healthy elderly people,

there is no relationship between hippocampal atrophy and decreases in cognitive function (MMSE, Clinical Dementia Rating : CDR), ApoE genotype, or blood pressure²⁴, and that in cases of MCI, the presence of hippocampal atrophy is a prognostic factor of increases in the advancement rate of subsequent hippocampal atrophy²².

In the results of our present study, significant differences in the hippocampal volume were observed between the two groups; however, the implications of these results for subjects without dementia are unknown. More recently, there have been reports regarding prognoses for hippocampal atrophy and decreases in subsequent cognitive function in longitudinal studies of healthy subjects^{28,29}. However, in both of these studies, the temporal changes in brain atrophy were studied by year, and it was reported that prognoses were possible for a transitional group of healthy subjects developing MCI. Therefore, it is difficult to directly compare these two reports and the results of our study, which examined hippocampal atrophy in a single MRI test for subjects without dementia.

Currently, there is a report by Morra JH, *et al.*²⁴ regarding the relationship between the presence of hippocampal atrophy and decreases in cognitive function in healthy

subjects, but no conclusions have been reached. Therefore, regarding the interpretation of our study results, further examinations will be necessary by obtaining image data of brain functions from Positron emission tomography (PET) and Single photon emission computed tomography (SPECT) imaging and temporal changes by year using MRI tests while conducting more detailed examinations of the cognitive function³⁰.

Presently, as the “85-year-old generation” is quickly approaching, and therefore maintaining a purpose of life and the closing of one’s valuable life with happiness and joy have now become major issues in our society.

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Table 1: Mean age and other data of the 230 subjects of Survey 1.

		Takarazuka Revue Company OG	General females
Total number		230	
Number of subjects		126	104
Mean age		80.7 ± 5.3 years old*	79.7 ± 7.1 years old
Age of starting art education		13.0 ± 4.5 years old	40.0 ± 23.4 years old
Age of stopping art education		27.7 ± 14.0 years old	53.5 ± 24.0 years old
Long-term occupations		Out of 126 subjects:	Out of 104 subjects:
	Homemaker	73 (57.9%)	65 (62.5%)
	Show business	27 (21.4%)	0 (0.0%)
	Self-owned business	17 (13.5%)	8 (7.7%)
	Company employee	7 (5.6%)	13 (12.5%)
	Educator	15 (11.9%)	19 (18.3%)
	Unemployed	14 (11.1%)	6 (5.8%)
	Other	10 (7.9%)	12 (11.5%)

*: Mean value ± standard deviation

For the general female group, art education refers to cultural activities.

Table 2: Mean age and other data of the 124 subjects of Survey 2.

	the OG group	the control group
Total number	124	
Number of subjects	62	62
Mean age	79.4 \pm 5.1 years old*	80.4 \pm 6.4 years old
Number of subjects having 10 years or more entertainment careers	24	-
Experience in culture activities	-	46
Continued art or cultural activities	9	7
Age of starting art education	13.0 \pm 4.7 years old	45.4 \pm 24.8 years old
Age of stopping art education	29.2 \pm 15.6 years old	57.1 \pm 25.1 years old

*: Mean age \pm standard deviation

For the general female group, art education refers to cultural activities.

Table 3: Mean age of the 31 subjects for MRI testing in Survey 3

	the OG group	the control group
Total number	31	
Number of subjects	16	15
Mean age	80.1 \pm 5.1 years old*	81.7 \pm 5.7 years old
Number of subjects having 10 years or more entertainment careers	7	-
Experience in culture activities	-	12
Continued art or cultural activities	7	8
Age of starting art education	14.8 \pm 3.6 years old	42.9 \pm 17.3 years old
Age of stopping art education	30.6 \pm 17.6 years old	61.3 \pm 20.5 years old

*: Mean value \pm standard deviation

Table 4: Comparison Between the Takarazuka Revue Company OG group and the general female group(Survey 1)

	Takarazuka OG group	General female group	χ^2
Subjects who answered, "I am forgetful."	n=55 (43.5%)	n=74 (71.4%)	5.71*
Subjects who answered, "I was sickly as a child."	n=38 (30.0%)	n=29 (27.6%)	0.16

* $p < 0.05$ (χ^2 test)

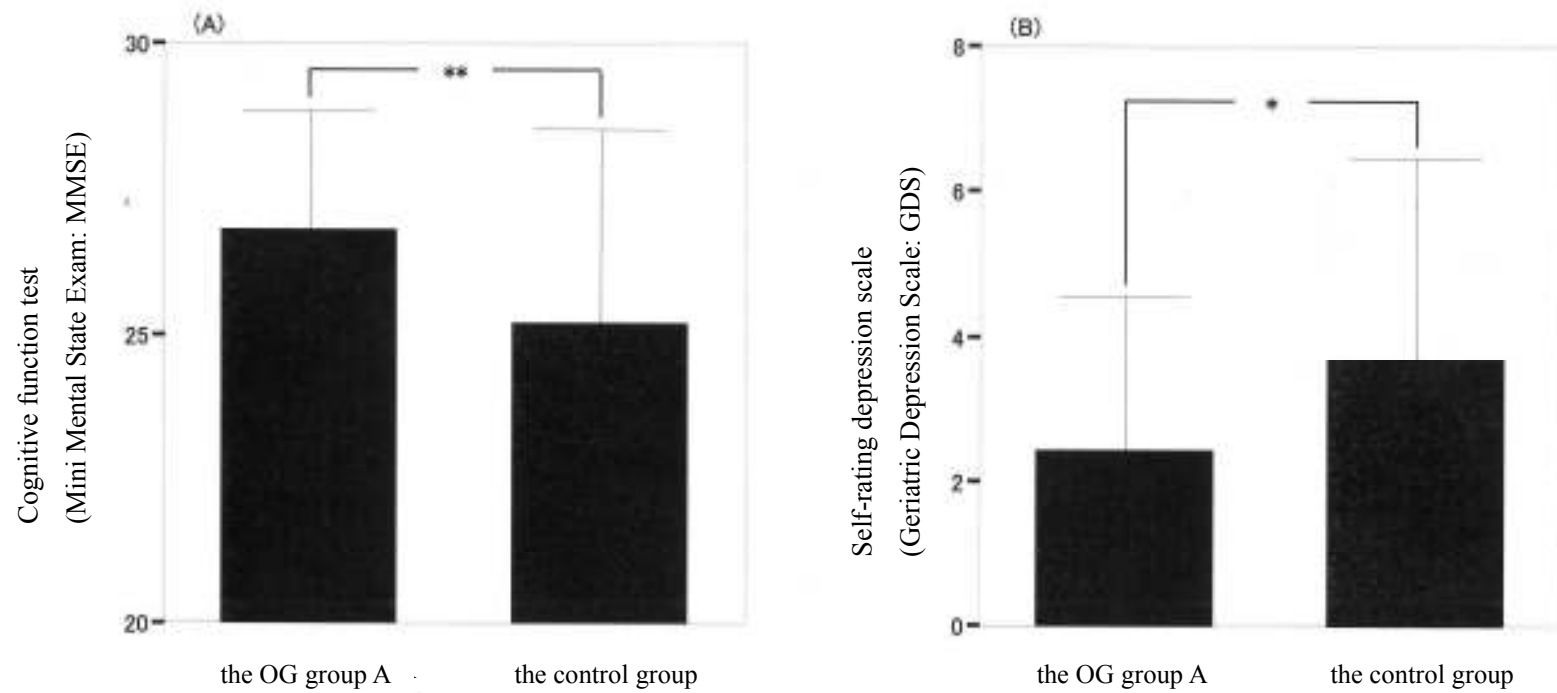
Figure Legends

Figure 1: Comparison between the OG group A (with entertainment careers of 10 years or more) and the control group. Survey2.

Figure 2: ADL and number of remaining teeth (anterior teeth, posterior teeth) in the OG group and the control group. Survey2

Figure 3: Comparison of left and right hippocampal volumes of the OG group and the control group. Survey3.

Figure 1



* $p < 0.05$, ** $p < 0.01$ (Student's t -test)

Figure 2

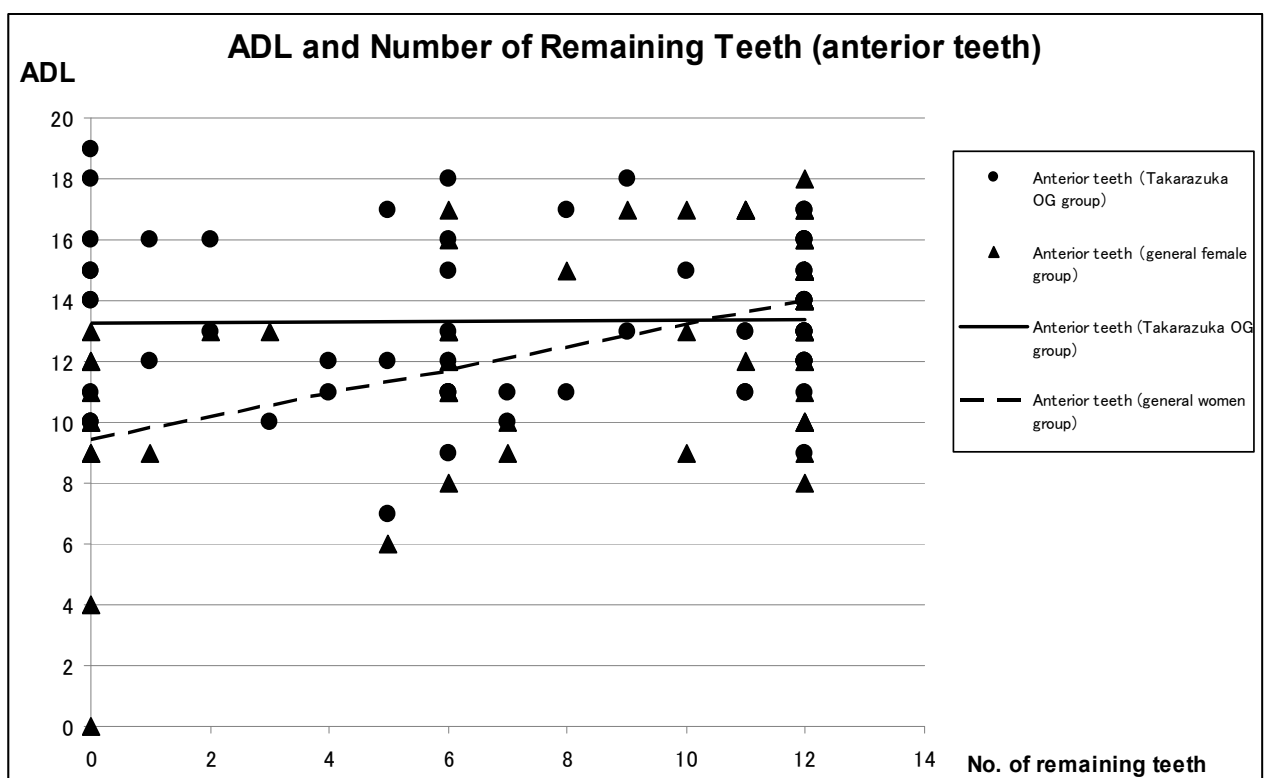
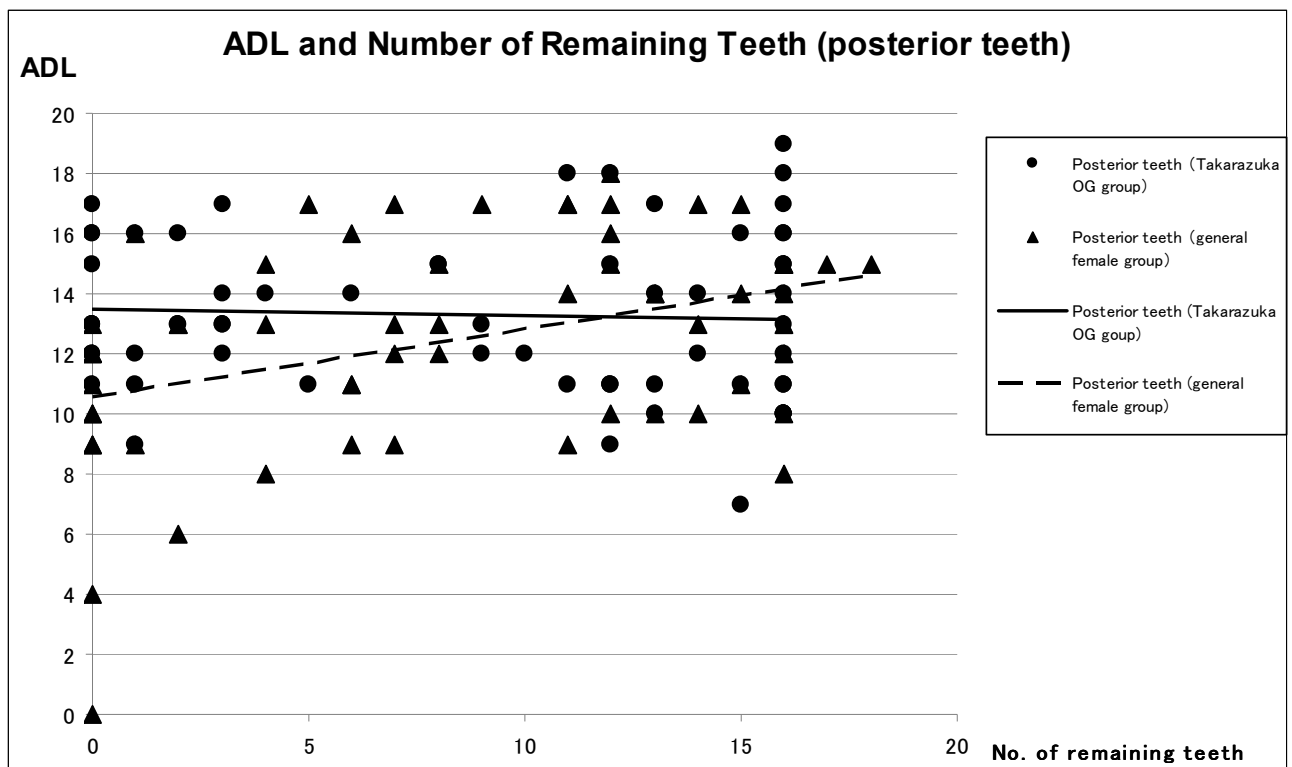
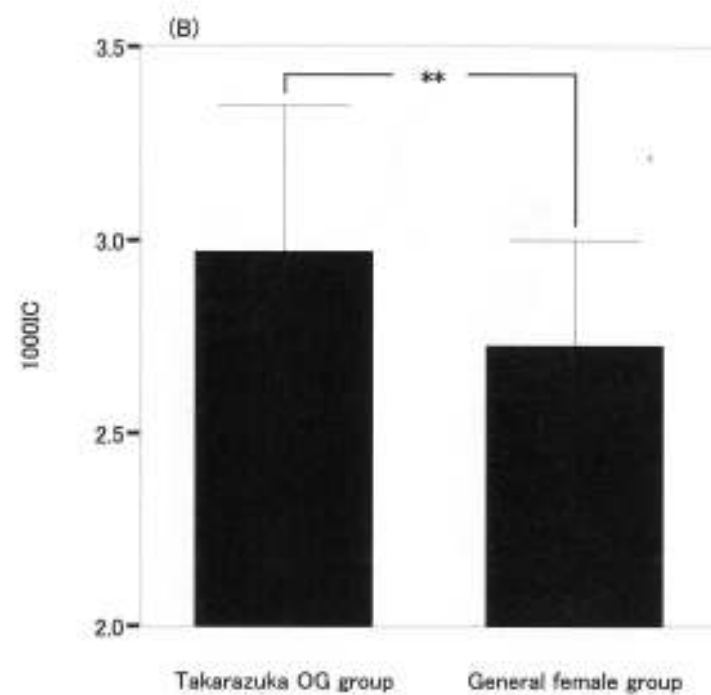
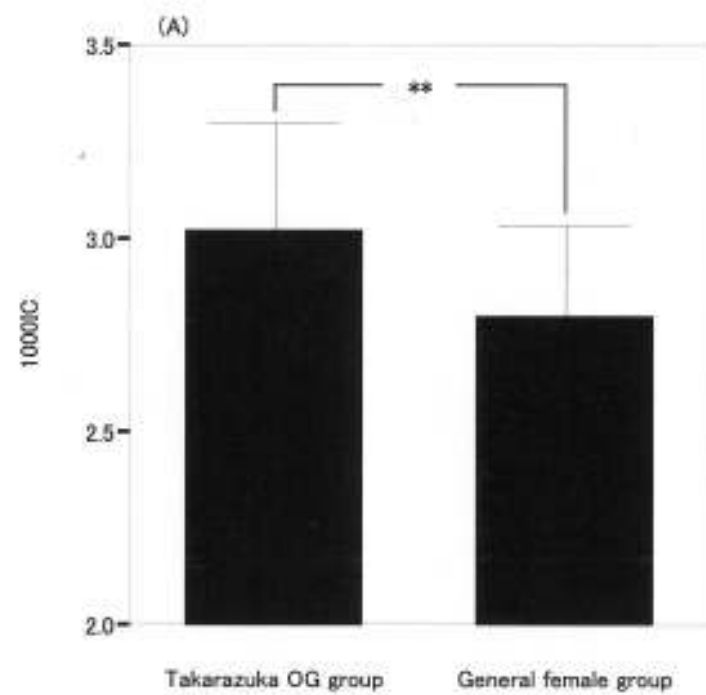


Figure 3: Hippocampal Volume (A) right, (B) left



****** $p < 0.01$ (Student's t -test)