

EFFECT OF MUSIC EXPOSURE ON THE WEIGHT AND BODY-LENGTH OF RAT-LITTERS

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Abstract

Music is related to stress reduction and increased levels of growth-hormone. In rat, music exposure since prenatal period was found to increase body-weight of 7-days-old litters and brain cells. Somatic growth was primarily influenced by growth-hormone and supported by psycho-physic condition. The objective of this study was to analyze whether music exposure since prenatal until 35 days post-natal period could affect the weight and body-length of the rat-pups. Four pregnant *Wistar* rats were daily exposed to one hour classic music (*Mozart*) every 17.30 PM since gestation period day one until the 22 litters were 35-days-old. Controls were 5 pregnant rats and their 36 litters caged in a different room with no music. Weighing and measuring the body-length (the most anterior point of nasal-septum to the base of the tail) were conducted at day 7, 25 and 35. Data were analyzed using Multivariate General-Linear-Model ($\alpha = 0.05$). It was revealed that the mean weight of the experimental litters was significantly higher than those of the controls either at day 7 ($p = 0.00$), 25 or 35 ($p = 0.006$). Difference of the body-length of the experiment and control animals only significant at day 25 ($p = 0.012$). Conclusion; Music exposure since prenatal period has significant influences on the weight of the rat-litters aged 7, 25 and 35 days and on the body-length of the 25-days-old litters. *Indonesian Journal of Dentistry 2006; Edisi Khusus KPPIKG XIV:325-328*

Key words: growth-hormone, music, rat

Introduction

In recent years it has been widely accepted that certain types of music could arise various positive biological effects either in human, plants, or animals. In human, music is capable of affecting biological condition through 'mind-body-connection' mechanism.¹ Many clinical studies had shown that music could influence respiration and heart rate, body temperature, blood-pressure and modulation of hormonal concentration². Listening to music could lead to decreased levels of cortisol and epinephrine and increased levels of prolactin and endorphin.^{2,3} One study in human reported that keyboard or drum exercise lead to increased growth

hormone (GH) level.² Similar effect was found in the healthy subjects exposed to techno music.⁴

In plants classic music by Bach and traditional music from India could stimulate corn, marigold, zinnia and petunia to have more flowers² while classic music modified with sounds of nature were related to the increment of polyamine and oxygen absorbed by Chinese cabbage and cucumber.⁵ Accordingly cattle exposed to Mozart's music² or Johan Straus's Blue Danube⁶ was reported to produce more milk.

In 1993 Rauscher reported that students exposed to Mozart's *sonata for two pianos in D major* for 10 minutes performed better spatial ability compared to those exposed to new age music or those with no

music.^{2,7} In relevance with this finding it was found that the same sonata given daily to rats resulted in significantly increased brain cells and expression of brain-derived-neurotrophic-factor (BDNF) and synapsin-1 (protein of synaptic growth).⁷ Another study found that daily exposure of a number of Mozart's classic compositions on pregnant rats caused higher amount of brain cells of the litters compared to those delivered from the rat-mothers which had no music.⁸ It has been postulated that music could affect intelligence and creativity by increasing the amount, complexity and coordination of brain cells and functional synaps.^{2,8} These findings also indicating that music exposure has a potency in increasing somatic growth. Puspitawati et al. had proved that music exposure since prenatal period is significantly related to body weight of 7-days old rat-litters.⁹

Growth is a continuous process that begins before birth and refers to increase in physical size. Since growth is a result of function of all body systems, clinically it most frequently concerned with weight, height and head circumference. Because it involves all the increment of increase in size weight is often considered as a good index of growth in general while height is usually refer to skeletal growth.¹⁰

Besides genetics and adequate diet, other factors that strongly affect growth are absence of stress and modulation of a number of hormones. In times of stress, adrenal cortex releases cortisol. Cortisol is known to have significant catabolic antigrowth effects. Conversely, growth hormone (GH) together with Insulin-like-growth-factors (IGFs) is metabolically anabolic for proteins, directing energy and amino acids into protein synthesis, which is an essential part of tissue growth. Although GH is released throughout life but its biggest role is during childhood. Severe GH deficiency in childhood could lead to dwarfism.¹¹

Studying previous findings that music exposures in rat could increased growth of brain tissue and body weight of 7 – days old pups, and in human have influence on emotional states, stress relieve and modulation of hormonal concentration including GH, and considering that body weight and height are common indicators of somatic growth which are significantly influenced by GH, the objective of this second preliminary study was to examine whether daily exposures of classic music since prenatal period could affect the body weight and length of rat litters aged 7, 25, and 35 days.

The empirical confirmation of the effect of music on somatic growth might be beneficial in

promoting the growth and the quality of the whole body and its organs. Now that the role of GH in odontogenesis becoming further discovered, empirical findings showing the relationship of music, somatic growth, and GH may give light to the possibility of utilizing music to increase the growth and/ or quality of the dentition.

Methods

Ten female *Wistar* rats aged 120 days were randomly grouped into experiments and controls. The two groups were caged in two separate rooms and fed standard diet *ad libitum*. Since a week before matting the 5 experiment rats were conditioned with daily 30 minutes music exposure. One rat was not becoming pregnant so only the remaining 4 rats were continuously given the daily 60 minutes music exposure since the first day of their gestation period until their litters were 7-days-old. Five control rats were kept in a same condition as those of the experimental rats but with no music.

Music exposure was given by playing a set of cassettes containing 8 selected numbers of classic music composed by Mozart. Music was played every day at 17.30 PM. Twenty-two experiment and 36 control litters were weighed using a manual triple beam balance (*Ohaus* capacity 2610gr), and their body-length (the most anterior point of nasal septum to the base of the tail in animals lying flat on their stomach) were measured using a caliper at day 7, 25, and 35. The mean weights and body-lengths of the two groups were compared and analyzed using General linear model (GLM) Multivariate with significance level 95% ($\alpha = 0.05$).

Results

To confirm that the general condition of the rat-mothers in the two groups were equal and so the litters might have an equal opportunity to grow optimally, the comparison of their initial weight (weight at day 1 of gestation period), weight before partus, weight increment (the difference between weight before partus and initial weight) and number of litters were analyzed using Mann-Whitney test with significance level 95% / $\alpha = 0.05$.

As shown in table 1, there were no statistical significant differences between the mothers of the control and the experiment groups either for their initial weight ($P = 0.221 > 0.05$), weight before

$P = 0.389 > 0.05$), weight increment ($P = 0.389 > 0.05$) or number of litters ($P = 0.169 > 0.05$).

Table 1 Weight at Day 1 and Last Day of Gestation Period, Weight Increment and Number of Litters of the Rat-Mothers

Variable	Group	N	Mean	SD	P
Weight at Day 1	Control	5	158.56 gr	19.79	0.221
	Experiment	4	140.23 gr	11.31	
Weight at Day 25	Control	5	212.22 gr	16.53	0.389
	Experiment	4	198.95 gr	20.91	
Weight at Day 35	Control	5	53.66 gr	6.32	0.806
	Experiment	4	53.82 gr	8.93	
Number of litters	Control	5	7.20 rats	1.30	0.169
	Experiment	4	5.75 rats	1.71	

$P = 0.389 > 0.05$), weight increment ($P = 0.389 > 0.05$) or number of litters ($P = 0.169 > 0.05$).

Table 2 Mean Weight and Body-Length of Rat Litters with and without Music With Sex as a Covariate.

Variable	Mean (gr) ± SD in (Controls)	Mean (mm) ± SD (Experimental)	P Value	P Value for Sex
Body weight at day 7	11.664 ± 1.171	13.192 ± 0.729	.00	.313
Body weight at day 25	38.204 ± 4.409	42.192 ± 3.245	.006	.472
Body weight at day 35	64.889 ± 6.550	70.923 ± 4.408	.006	.585
Body length at day 7	6.529 ± 0.320	6.585 ± 0.248	.651	.221
Body length at day 25	9.931 ± 0.646	10.492 ± 0.545	.012	.883
Body length at day 35	12.327 ± 0.688	12.577 ± 0.939	.358	.992

Statistical analysis showed that sex is not significantly related to weight and body length of the animals ($p > 0.05$). Therefore in analysing the data in this study, the variable sex could be ignored. P value for differences in body weight between control and experimental animals were 0.00 (7 days old) and 0.006 (25 and 35 days old) < 0.05 . This confirmed that music exposure given to the experimental animals was significantly related to their body weight. Conversely, only body-length at day 25 was

significantly different between experimental and control animals ($p = 0.012 < 0.05$).

Discussion

It has become apparent that different types of music induce different neuroendocrine changes. In human, personal experiences and temperament may influence the wide inter-individual variability in response to music⁴. The present study used laboratory animals so that such subjective variability in response to music could be controlled.

Positive biological effects could be gained by using various types of music. However one among several types of music that has been mostly investigated in relation with its positive biological effects² and had been found to be associated with increased body weight⁹ and growth of brain tissue in rats^{7,8} is classic music composed by Mozart. This was the consideration when deciding to use Mozart's composition in this study.

This study showed that the weight of the rat-litters exposed to music was significantly higher than those with no music either at day 7, 25 or 35 days. This result is in relevance with previous studies that music could evoke a positive biological effect and supports a hypothesis that positive biological response stimulated by music may lead to increased somatic growth.

There are some possibilities of the physiological mechanisms underlying the results of this study. This could be supported by the results of previous studies in which music exposure were related to increased concentration of prolactin in human or increased milk production in cattle². In this study music exposure was given since prenatal period, therefore it might resulted in the increment of prolactin which is essential in stimulating milk production of the rat-mothers which in turn would optimizing the growth of the litters.

In human music is a powerful tool in evoking emotions. Listening to music can be effective in reducing the negative effects of stress³. It has been accepted too that there is a link between the mind and the body. According to this neuroimmunomodulation model there is a strong bi-directional relationship between psyche, nervous, endocrine and immune systems. Therefore anything affecting one of those four systems would stimulate response in others. Physical or emotional stress could lead to disturbed homeostasis and results in alteration of immunoneuroendocrine functions. Conversely, absence of stress would lead to increased immune

system and better homeostasis¹¹. Even though there was not any reports on the effect of music to emotional state or to hormonal concentration in rat but the finding that music exposure could increase milk production of cattle lead to a hypothesis that calming music could reduce stress in animals just as it does in human⁵.

For normal growth to take place GH is required throughout life particularly in childhood. The overall effect of GH is to promote somatic growth^{9,12}. An index universally used to measure growth especially in the early years of life is body weight. Therefore, body weight could be presumed as an indicator of the extent of GH effect on the somatic growth, and thus the higher body weight of rat-litters exposed to music compared to those without music in this study might be an indicator of the increased concentration of GH in those animals.

The most striking and obvious effect of GH is in stimulating linear growth of the skeleton and growth of a number of tissues in the body. Growth hormone holds prominent role in remodeling, regulation of bone mass and postnatal longitudinal growth¹³. Therefore significant increased of GH may lead to significant increased in long bones which further results in increased body-length. In this study it was found that the body length of rat litters exposed to music was higher than those without music even though these differences only significant at day 25. The explanation of this finding may be related to the various accelerated-growth phase at certain ages during organism's lifetime¹⁰. Rats reach their pubertal period at 50 days-old¹⁴, so that at 25-days old they might be analog with the first 2 years of human life where the active phase of somatic growth is at its peak.¹⁰

Conclusion

This study showed that body weight of *Wistar* rat litters aged 7, 25 and 35 days was strongly associated with the daily exposures of one-hour Mozart's classic music given since prenatal period. Similarly, the body length of the animals was also affected by the given music exposure although the significance of this effect is influenced by the age of the animals. Some possible physiological mechanisms underlying this phenomenon are as follows; 1) Music exposure since prenatal period lead to increased secretion of prolactin in the rat-mothers so that the litters could get more milk, 2)

Music exposure lead to reduced stress either in rat-mothers or in the litters and thus lead to a better immune system and homeostasis, 3) Similar to the previous studies in human, music exposure given to the rat-mothers and their litters resulted in increased concentration of GH.

The positive effect of music in stimulating somatic growth by using body weight and body length as parameters as shown by this study brings a responsibility to further investigating the mechanism of effect of music on stimulating somatic growth in cellular and molecular levels so that the application of music might be further optimized to increase the quality of body health and its organs including the dentition.

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