

Does going to an amusement park alleviate low back pain? A preliminary study

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Background: Low back pain is often called nonspecific pain. In this type of low back pain, various emotions and stress are known to strongly affect pain perception. The purpose of this study is to investigate how the degree of low back pain changes in people with chronic mild low back pain when they are inside and outside of an amusement park where people are supposed to have physical and psychological enjoyment.

Methods: The subjects were 23 volunteers (13 males and 10 females) aged 18 to 46 years old with a mean age of 24.0 years who had chronic low back pain. Visual analog scale (VAS) scores of low back pain and salivary amylase levels (kIU/L) of all subjects were measured at five time points: immediately after getting on the bus heading for the amusement park; 10 minutes, 1 hour (immediately after boarding the roller coaster), and 3 hours (immediately after exiting the haunted house) after arriving at the amusement park; and immediately before getting off the bus returning from the park.

Results: The three VAS values in the amusement park (10 minutes, 1 hour, and 3 hours after arriving at the amusement park) measured were significantly lower ($P < 0.05$) when compared with the other two values measured immediately after getting on the bus heading for the amusement park and immediately before getting off the return bus. In salivary amylase levels, there were no statistically significant differences among the values measured at the five time points.

Conclusion: Low back pain was significantly alleviated when the subjects were in the amusement park, which demonstrated that enjoyable activities, though temporarily, alleviated their low back pain.

Keywords: low back pain, emotion, salivary alpha-amylase activity, enjoyment activities, psychological stress

Introduction

In Japan, there are many patients suffering from low back pain. The 2010/2011 National Livelihood Survey¹ reports that the number of Japanese people with low back pain per 1000 population is 87.4 (8.7%) in males and 117.9 (11.8%) in females, a very large proportion indeed.

It has been reported that, while pain is exacerbated by physical and psychological stress, it is alleviated when doing something fun, such as listening to music and appreciating paintings.²⁻⁵ In particular, low back pain is often called nonspecific pain and various emotions and stresses are known to strongly affect pain perception.⁶ For example, it has been reported that music therapy alleviates postoperative pain whereas listening to unhappy music increases the pain,⁷ and that pain decreases when looking at pleasant pictures but it increases when looking at unpleasant pictures.⁸ Sports, daily

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exercise, and gymnastics are also effective in alleviating low back pain,⁹ but the most important thing is the notion of pleasure. In other words, when a person is engaged in enjoyable activities such as taking a bath,¹⁰ being absorbed in a hobby, or eating a favorite food, pain is assumed to be alleviated by various mechanisms, including cerebral and spinal modulation of pain by emotions and increased production of the brain hormone endorphin.^{3,8,11}

In an effort to investigate how the degree of low back pain changes in people with chronic mild low back pain when they are inside and outside an amusement park where people are supposed to have physical and psychological enjoyment, we conducted the following study and herein report our findings.

Methods

The subjects were 23 volunteers (13 males and 10 females) aged 18 to 46 years old with a mean age of 24.0 years who had chronic low back pain. Chronic pain was defined as constant pain lasting for the past 3 months or longer with a pain intensity score of 20 or higher using the visual analog scale (VAS; 0–100 mm). Severe pain was defined as a VAS score of 60 or higher, mild pain as 20 to <60, and slight pain as <20. All participants of this study had VAS scores between 20 and <60 (ie, mild pain) during the preceding 3 months or longer.

The volunteers who participated in this study were recruited mainly from among students of our university by informing them in advance that the subjects would go to an amusement park by bus, that the degree of their low back pain would be investigated in that park, and that the bus fare and the amusement park ticket would be free. This study was conducted with the approval of the ethics committee of Mie University, Tsu City, Japan (No 2346) in advance, and we obtained consent to participate in this study from all subjects immediately before beginning the study. The Japanese Orthopedic Association Back Pain Evaluation Questionnaire (JOABPEQ) and Maudsley Personality Inventory (MPI) were administered to all subjects. Results of the JOABPEQ showed that none of the subjects had disabling low back pain. The MPI showed that none of the participants had any apparent personality test abnormalities.

Lumbar spinal magnetic resonance images (MRIs) of all subjects were taken, and the subjects were asked whether they liked amusement parks or not. Also, their VAS scores of low back pain and salivary amylase levels as a stress marker were measured in real time. VAS scores of low back pain were measured by having the subjects indicate the level of

their low back pain on a 100 mm straight line at five time points: A point, immediately after getting on the bus heading for the amusement park; B point, 10 minutes after arriving at the amusement park; C point, 1 hour after arriving at the amusement park (immediately after boarding the roller coaster); D point, 3 hours after arriving at the amusement park (immediately after exiting the haunted house); and E point, immediately before getting off the bus returning from the park. Salivary amylase levels (kIU/L) were measured five times at the same time points (A–E points) when VAS scores were measured, by having all subjects place a measuring tip under the tongue for about 30 seconds and by using a portable Salivary Amylase Monitor[®] (NIPRO Corporation, Osaka, Japan).

Salivary amylase levels increase when the sympathetic nerve is excited, and therefore it should increase when under physical and psychological stress.¹² Since this value would be significantly affected by food and drink, the participants were forbidden from eating and drinking for 30 minutes before each measurement.

For the control group, this study enrolled 18 individuals without low back pain, and their salivary amylase levels were also measured. In the statistical examination, the presence or absence of uniformity was tested with the Kruskal–Wallis test for the five measurements of the low back pain VAS scores and of the salivary amylase levels. When uniformity was not found, a post hoc analysis was performed using the Wilcoxon test with Bonferroni correction for multiple comparisons among the five measurements.

Results

The results of the lumbar spine MRIs of the 23 subjects showed that nine of them had very mild degeneration and/or bulging of the intervertebral disc and 14 of them had no abnormality. No abnormal finding such as an obvious herniated disc was observed in any of them. As regards the question of whether they liked amusement parks or not, all of them answered, “I like amusement parks.”

The mean low back pain VAS score (Table 1) was 36.3 at the measuring point immediately after getting on the bus heading for the park (A point), <20.0 at all three measurements while in the amusement park (B, C, and D points), and 33.4 at the measuring point immediately before getting off the return bus (E point), showing that VAS scores were clearly lower when the participants were in the amusement park. When the Kruskal–Wallis test was performed, uniformity was not found in the data of all measurements, and the three VAS values of B, C, and D points were significantly

Table 1 VAS scores and salivary amylase levels at each point in 23 subjects with low back pain

Measured point	A	B	C	D	E
Mean VAS score	36.3 ± 17.2	15.7 ± 10.5*	14.4 ± 9.6*	14.7 ± 10.8*	33.4 ± 15.8
(range)	(20.0–56.1)	(0–27.2)	(0–30.5)	(0–26.5)	(9.5–45.5)
Mean salivary amylase level	16.7 ± 14.0	22.8 ± 17.6	24.0 ± 27.2	25.0 ± 20.8	15.8 ± 10.0
(range)	(3–47)	(0–39)	(0–45)	(0–41)	(0–31)

Notes: A point, immediately after getting on the bus heading for the park; B point, 10 minutes after arriving at the amusement park; C point, 1 hour after arriving at the amusement park; D point, 3 hours after arriving at the amusement park; E point, immediately before getting off the bus returning from the park; *the three VAS scores of B, C, and D points were significantly lower (all $P < 0.05$) than the scores of A and E points.

Abbreviation: VAS, visual analog scale.

lower (all $P < 0.05$) than the other two VAS values of A and E points. The data by severity of low back pain categorized by our definition are shown in Table 2.

The mean salivary amylase level (Table 1) was 16.7 at A point, ≥ 20 at B, C, and D points, and 15.8 at E point; thus, the values were generally higher when the subjects were in the amusement park. When the Kruskal–Wallis test was performed, uniformity was found in the data of all five measurements, indicating no significant difference in their salivary amylase levels.

The data of the control group (without low back pain), shown in Table 3, demonstrate no statistically significant differences among the five points. In the data of the salivary amylase levels, there are no significant differences between the low back pain group and the control, non-pain group.

Discussion

The results of our study revealed that the enjoyable activity of going to an amusement park alleviated, though temporarily, low back pain. There has been no other report in the past that actually took the subjects to an amusement park and measured their low back pain in real time, which makes our study valuable.

It may be well known that pain can be alleviated by concentrating on something fun or one's favorite pastime, and this idea is applied as distraction therapies in clinical

practice with the use of music, images, movies, video games, and other tools for distraction.^{13–15} However, all of these tools typically involve virtual reality experiences and imagination. Real-life-experience studies on the effects of distraction have been rare, but include studies of pain reduction by touching animals in hospitals¹⁶ or by traveling to have real experience of amusement park attractions as in our study. In this study, the severity of chronic low back pain was mild in all participants with low back pain. We believe that the results of this study are noteworthy and are novel in that even mild low back pain was alleviated by amusement park experiences.

The possibility of a Hawthorne effect^{17,18} cannot be excluded if some participants knew the purpose of this experiment and were biased to report a decrease in low back pain immediately after an enjoyable activity. However, we told the subjects of this study only that they were going to get on a bus and go to an amusement park, take a ride on a roller coaster and go into a haunted house there, and then come back; we did not tell them anything about the objective of the study, such as evaluation of the association between low back pain and stress.

Shirasaki et al¹⁹ reported that the salivary amylase level was significantly correlated with VAS score, and we measured it assuming that this measurement could objectively evaluate the degree of pain. However, it is still controversial whether the salivary amylase level can serve as a marker of stress and pain.^{20,21} Actually, the values measured in the amusement park were higher in our study, and we could not find collateral evidence that pain and stress were alleviated in the park. Adam et al²² reported that salivary amylase may reflect levels of emotional arousal including high arousal positive emotions (feeling strong, active, vigorous, excited), rather than being specific to stress or emotions of negative valence (angry, stressed, nervous, worried). Thus, the higher values of salivary amylase levels measured in this study when the participants were in the amusement park may also reflect excitement of the sympathetic nerve as a result of increased

Table 2 The number of persons categorized at each level of severity of low back pain at each point

	A	B	C	D	E
No pain	0	2	3	1	0
Slight pain	5	11	12	13	6
Mild pain	18	10	8	9	17
Severe pain	0	0	0	0	0

Notes: Severe pain was defined as a visual analog score of 60 or higher, mild pain as 20 to <60 , and slight pain as <20 in this study. A point, immediately after getting on the bus heading for the park; B point, 10 minutes after arriving at the amusement park; C point, 1 hour after arriving at the amusement park; D point, 3 hours after arriving at the amusement park; E point, immediately before getting off the bus returning from the park.

Table 3 VAS scores and salivary amylase levels at each point in subjects without low back pain

Measured point	A	B	C	D	E
Mean VAS score	0.2 ± 0.2	0.2 ± 0.1	0.3 ± 0.2	0.3 ± 0.2	0.2 ± 0.1
(range)	(0–0.5)	(0–0.5)	(0–0.8)	(0–0.7)	(0–0.7)
Mean salivary amylase level	18.3 ± 16.0	19.8 ± 17.6	19.8 ± 18.2	19.1 ± 16.3	17.3 ± 15.0
(range)	(2–37)	(0–38)	(0–39)	(3–38)	(3–33)

Note: There were no statistically significant differences among the five points.

Abbreviation: VAS, visual analog scale.

vigor on the part of the participants rather than an increased stress. As for the methods of saliva amylase measurements, unlike measurements in hospitals where quiet small rooms are available for participants to be alone for at least several minutes to assure comfortable resting to reduce the influence of physical activity and stress, individual participants in this study rested for several minutes in only a relatively quiet place within the constantly noisy amusement park before each saliva amylase measurement. Thus, a better environment for saliva amylase measurements with less physical activity and less stress may have provided better data. Moreover, it is supposed that measurements of calcitonin gene-related peptide (CGRP) in saliva^{23,24} are associated with chronic pain, and they may provide important data.

Limitations of this study include that the number of subjects was small, the subjects were only those with mild low back pain, the mean age of the studied group was rather low in this current study, and only those who liked amusement parks participated. Regrettably, we did not ask the study participants about whether they participated alone or with friends, or whether they had previously visited the amusement park, although these confounding factors could affect the study results.

In the future, we would like to increase the number of subjects to conduct similar studies in subjects with chronic low back pain with VAS scores ≥ 50 and in subjects who do not like amusement parks. Further studies should be designed to analyze potential confounding factors and to evaluate the impact of pleasurable activities other than amusement parks for the purpose of confirming the robustness of our conclusion.

Conclusion

We investigated the degree of low back pain in 23 subjects with mild low back pain in real time when they were inside and outside an amusement park. The results showed that low back pain was significantly alleviated when the subjects were in the amusement park, which demonstrated that enjoyable activities, though temporarily, can alleviate low back pain.

Disclosure

The authors report no conflicts of interest in this work.

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