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RESEARCH ARTICLE

Effect of oral sucrose on pain perception among young adults

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ABSTRACT

Background: Among tastes, the sweetness is associated with a pleasurable experience. Sucrose, the monosaccharide, has a sweet and pleasant taste. Pain is defined as an unpleasant sensory and emotional experience associated with an actual or potential damage. It motivates the individuals to withdraw from the damaging situation, thereby protecting the corresponding body part. Cold pressor test is generally used to measure the associated changes in various cardiovascular parameters. Cold pressor test can also be used to measure pain threshold and pain tolerance. **Aim and Objective:** The aim of this study was to assess the effect of oral sucrose on time taken for pain perception and pain tolerance among young adults. **Materials and Methods:** This interventional study was carried out among 400 adult male students. Out of the 400 students, 200 students were subjects, and 200 students were controls. Institutional Ethical Committee Clearance was obtained before the conduction of the study. All the students were instructed to perform cold pressor test using 4°C cold water. Thereafter, the subjects were given oral sucrose and the controls were not. Once again, all the students were instructed to repeat the cold pressor test. **Results:** The mean duration of pain perception before and after oral sucrose was 13.5 ± 7.3 s and 21.2 ± 15 s, respectively. Pain tolerance before and after oral sucrose was 41.3±28.1 s and 64.3±59.9 s, respectively. **Conclusion:** The study results suggest that the time taken between the pain onset and the pain tolerance was longer when the subjects held sucrose than when they held nothing in their mouth.

KEY WORDS: Cold Pressor Test; Sucrose; Pain

INTRODUCTION

Among the five basic tastes, the sweetness is the one which is associated with a pleasurable experience. Sucrose, another name for table sugar, is composed of two monosaccharaides – glucose and fructose. It has a sweet taste and is pleasant to eat. The neural system detects sweet taste. Palatability is detected by both the chemical and neural systems in the brain. Benzodiazepines and opioid systems are related to palatability.[1]

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Sweet substances are sensed by taste receptors that are paired to G – Proteins which will depolarize the cells. Depolarization of cells will increase the free calcium levels in the cytoplasm which will induce more and more release of neurotransmitters. According to the Labeled line theory,[2] there are sucrose – best nerve fibers. International association for the study of pain has defined pain as "an unpleasant sensory and emotional experience associated with actual or potential damage." It causes individuals to withdraw from the damaging stimuli and thereby protecting the corresponding body part and to avoid similar experiences in the future.

Cold pressor test is used universally as a cardiovascular test which is done by immersing the subject's hands in cold water for 60 s and recording the changes in blood pressure and heart rate.

Some other parameters that can be studied from the cold pressor test are pain threshold and pain tolerance. This is done

by instructing the subject to immerse his/her hand in cold water of temperature 4°C[3] for as long as he/she can. Once pain is perceived, the subject should intimate the researcher. Once they cannot tolerate the pain, they can remove their hand. This gives the measure of pain perception time (time taken to first feel the sensation of pain) and pain tolerance time (total time minus pain perception time).

The administration of oral sucrose has an analgesic effect on both children and adults. Oral sucrose is found to be safe, effective, and convenient for reducing crying in newborns.

The pleasure sensation felt on tasting sucrose is due to the increase in endorphin levels in the blood. Endorphins are known to reduce stress and pain. Studies[4-6] have reported that tasting sucrose helps to alleviate stress in rats. Consumption of sucrose increases endogenous opioid peptide in human plasma. An increase in endogenous opioid peptide increases the time taken for pain perception and pain tolerance.[7]

Aims and Objectives

The objectives of this study were as follows:
1. To assess the effect of oral sucrose on time taken for pain perception among young adults
2. To assess the effect of oral sucrose on pain tolerance among young adults.

MATERIALS AND METHODS

This non-randomized interventional study was carried out among 400 healthy young male students. Male students aged between 17 and 25 years without neurological disorders, diabetes, febrile illness, skin lesions and diseases, common cold, sinusitis, oral and tongue lesions, and hypothyroidism were included for the study.

Out of the 400 students selected, 200 students were given intervention with oral sucrose and subjected to cold pressor test and 200 students were age- and gender-matched controls. The controls were subjected to cold pressor test without giving oral sucrose.

Institutional Ethical Committee Clearance was obtained before the conduction of the study. Informed consent was obtained from all the subjects and controls after explaining the details of the study. Demographic data were collected. Clinical history was obtained to rule out any neurological disorders, diabetes, febrile illness, skin lesions and diseases, common cold, sinusitis, oral and tongue lesions, and hypothyroidism. Then, the cold pressor test was performed on both the subjects and controls.

Cold Pressor Test – Procedure

The subject was asked to immerse his hand in a tray containing cold water (4°C). Alcohol thermometer was used to measure the temperature of water. They were instructed to inform the investigator, at the earliest feel of pain. They were instructed to remove their hand once they were not able to tolerate the pain.

Time recording was done using a timer when the subject immerses his hand in cold water, when the subject first feels the pain and when the subject removes his hand from cold water when he cannot tolerate the pain. Pain perception time is the time interval between the times of immersion of hand in cold water and first feel of pain. Pain tolerance time is the time interval between pain perception and removal of the hand from cold water (Pain tolerance = Total time of immersion of hand in cold water – Pain perception time).

The cold pressor test was repeated on the next day after administering oral sucrose in the study group and without administering oral sucrose in the control group. The subject is asked to place oral sucrose-rock candy (kalkandu) in his mouth.[8] Quantity of rock candy is 100 equal small sized crystals (approximately 8 g). The subject is instructed not to bite or swallow the rock candy. He should keep it in their mouth until he finishes the cold pressor test (salivary secretion can be swallowed).

Statistical Analysis

Data are expressed as Mean ± SD. A comparison test of significance used was paired and unpaired "*t*-test." The level of significance was taken at <0.001. SPSS Licensed statistical software version 16 was used.

RESULTS

The study included 200 study subjects in the intervention group and 200 age- and gender-matched controls. Pain perception time and pain tolerance time were recorded in the datasheet in seconds.

In this study, we were able to observe that the mean duration of pain perception before oral sucrose was 13.5 ± 7.3 s [Tables 1 and 2] and after administration of oral sucrose the pain perception is found to be 21.2 ± 15 s [Table 3].

The total duration of time taken to perceive the pain after the consumption of oral sucrose was found to be higher when compared with the duration of time to perceive the pain before the consumption of oral sucrose.

The mean duration of pain tolerance before oral sucrose was 41.3 ± 28.1 s [Tables 1 and 2] and after administration of oral sucrose the pain tolerance was found to be 64.3 ± 59.9 s [Table 3].

The total duration of time to tolerate the pain after the consumption of oral sucrose was found to be higher when compared with the duration of time to tolerate the pain before the consumption of oral sucrose.

Table 1: Comparison of pain perception and pain tolerance in the control group

Pain parameters	Control group		*P*-value
	Day 1 (without oral sucrose)	Day 2 (without oral sucrose)	
Pain perception (in s)	13.2±7.2	13.2±7.3	0.893
Pain tolerance (in s)	40.0±28.2	39.8±28.2	0.299

Table 2: Comparison of pain perception and pain tolerance in study group

Pain parameters	Study group		*P*-value
	Day 1 (without oral sucrose)	Day 2 (with oral sucrose)	
Pain perception (in s)	13.5±7.3	21.2±15.0	0.000
Pain tolerance (in s)	41.3±28.1	64.3±59.9	0.000

P<0.001 – significant

Table 3: Intergroup comparison of pain perception and tolerance on day 2

Pain parameters	Control group on day 2	Study group on day 2
Pain perception (in s)	13.2±7.3	21.2±15.0*
Pain tolerance (in s)	39.8±28.2	64.3±59.9*

Un paired "*t*-test" between study and control groups on Day 2. **P*<0.001

From this study, we were able to observe that the time taken for pain perception and pain tolerance was increased and was highly significant after administration of oral sucrose.

The study included 200 study subjects and 200 age- and gender-matched controls. Pain perception time and pain tolerance time were recorded in the datasheet in seconds.

DISCUSSION

In the study, we were able to observe that the mean duration of pain perception before oral sucrose was 13.55 s and after sucrose intake was 21.27 s. Moreover, the pain tolerance before oral sucrose was 41.33 s and after sucrose intake was 64.33 s. Therefore, the time taken for pain onset and the duration of pain tolerance was longer when the subjects held sucrose than when they held nothing in their mouths.

Many studies have shown the analgesic effect of intraoral sucrose in newborn babies.[9-11] Very few studies have been conducted to find out the analgesic effect of intraoral sucrose in adults. The present study has addressed the question of whether intraoral sucrose exerts analgesic effects in adults. We have found that sucrose, apart from having a hedonic value (exerting pleasant sensation), has also changed the pain threshold from lower to higher which is very much corroborated with that by Lewkowski *et al*., 2003[12] and Priya *et al*., 2015[8] who have found that the duration of pain tolerance was longer when the subjects held sugar in their mouth. The possible mechanism behind this increase in the time taken for pain perception and pain tolerance is by the release of endogenous opioids which modulate the pain by blocking the receptors for pain transmission. The evidence of the role of endogenous opioids in pain tolerance was shown by Blass *et al*.[9] Sweet taste stimulates opioid activity in human infants.[13-23] Another possibility of sucrose-induced analgesia might be the involvement of centrally mediated analgesia. Sucrose might stimulate descending pain modulation. This is shown by Anseloni *et al*.[24] in neonatal rats.

Strength of the Study

Pepino and Mennella,[25] in their study, found that oral sucrose had an analgesic effect in children but not in adult women. Since their study included only women, their findings cannot be generalized to all adults. In our study, we have compared the pain tolerance among young healthy adult males.

Limitations of the Study

Endogenous opioid levels in the subjects were not measured. Gender variation for the effect of intraoral sucrose-induced analgesia was not done, which can be taken up for future research.

CONCLUSION

The presence of sugar in the mouth increases the duration of onset of pain and pain tolerance. This shows that there is a relationship between tasting a sweet substance and analgesia in adults.

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