Effect of Humour on Pain Perception among Young Healthy Indian Adults Using Cold Pressor Task

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ABSTRACT

Background

Currently there is little research, especially in India, which has looked at the physiological effects of humour on pain perception.

Objective

To compare pain sensitivity across the three arms of intervention (control, neutral and funny videos). And to investigate the relationship between a) cardiovascular responses across and within each arm, b) pain sensitivity and resting blood pressure, pulse rate, c) humour trait with pain sensitivity.

Method

Subjects were exposed in random order to cold pressor task, during which they either watched a 'neutral video' or 'funny video' or did not watch any video. During the intervention, pain threshold and tolerance were recorded. Systolic and diastolic blood pressure, and pulse rate were measured before and after intervention. Pain unpleasantness was recorded post intervention.

Result

Neither humorous nor neutral videos had a significant effect on pain threshold, tolerance and unpleasantness and cardiovascular responses. There was significant difference between the pre and post values of cardiovascular measures within neutral and funny video arms. In the 'no video' arm, negative correlations were found between resting blood pressure and pain unpleasantness, and between delta diastolic blood pressure and pain threshold. Humour trait and subject's self-rating of pain tolerance had no effect on both pain sensitivity and cardiovascular responses to cold pain.

Conclusion

Humorous distraction had no effect on objective or subjective pain measures or cardiovascular responses to cold pain exposure. There was a significant difference in the pre-post values of cardiovascular measures within neutral and funny video arms.

KEY WORDS

Cardiovascular responses, Cold pressor task, Humour, Pain perception

INTRODUCTION

Pain is a significant recurring symptom in clinical practice, often described as an unpleasant sensory-cum-emotional experience.[1-4] The multidimensional concept of pain provides the basis for multi-faceted approach to pain management.[2,5-7]

Studies using pain sensitivity measures, mostly from outside India, have shown that humour can alter pain tolerance.[8-10] The effect of humour on pain is through the release of endorphins, lowering of anxiety, and the distraction.[11] Pain perception is influenced by several factors such as age, gender, BMI, diet, ethnicity, genetics, social, cultural, geographic influences.[12-18] Pain sensation is altered by the trait (sense of humour) and mood (cheerful, serious or bad mood) of the person.[9,19-22] Currently, in India, there is minimal research focusing on effect of humour on pain perception. Our study employs the cold pressor task to explore the effect of humorous videos on pain perception in comparison with the effect of neutral videos or no video. It also explores the influence of humour trait, as determined by the STCI scale.[19] Cold pressor task is a standard experimental pain model and is more clinically relevant as a surrogate than heat pain.[5,16,23] including for the cardiovascular assessment.[2-4,24]

The primary objective of the study was to compare pain sensitivity across three arms of interventions - control, neutral videos and funny videos. Secondary objectives were to investigate the relationship: a) of cardiovascular responses across and within each arm. b) between pain sensitivity and resting blood pressure and pulse rate. c) between humour trait (STCI) with pain sensitivity and cardiovascular responses.

METHODS

The study was a quasi-experimental pre-post study design, prospective interventional study conducted in the laboratory of the Department of Physiology of the Institution. Institutional Ethics Committee (IEC Study Ref No: 287/2019, dated 14/11/2019) approval was obtained.

A pilot study was conducted for the selection of neutral and funny videos to be used for the main study. Following online written informed consent, 15 subjects age and gender matched to the subjects of the main study, were recruited. Participants attended an online meeting on Microsoft Teams (due to the pandemic situation during the pilot part of the study), to watch and rate the videos. Four funny videos and 4 neutral videos were selected by the investigators from free and open access sources on public domain. Funny videos were clips from 'Just for laugh gags' and 'Mr. Bean' shows. Neutral videos were those that did not evoke any major emotional responses in individuals, like videos of sea waves and the sunset. All video clips were silent. The videos were randomized and labelled A, B, C, D, E, F, G and H. The participants rated the videos for funniness on a standardized scale of 0 to 10 (fig. 1). Median scores of the funniness rating were compared. The video which was rated the highest was chosen as the 'funny video' and the video which was rated the least was chosen as the 'neutral video' to be used for the main study.[10]

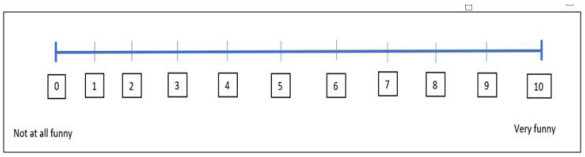

Figure 1. Rating scale: funniness of the video

The State Trait Cheerfulness Inventory (STCI) questionnaire is a 60 item validated questionnaire in a 4 point answer format providing scores that classify subjects into traits of Cheerfulness (STCI-T CH), Seriousness (STCI-T SE), and Bad Mood (STCI-T BM).[19,20] Permission to use the questionnaire for the study was obtained from the researchers who developed it. The questionnaire was filled by subjects of both the pilot and the main studies at the start of each. The STCI scoring in the pilot revealed that all 15 participants belonged to trait cheerfulness.

The 15 participants from the pilot study were recruited for calibration of the instruments after informed consent. The instruments required for the main study, namely the OMRON digital blood pressure apparatus, stadiometer and weighing machine were calibrated. The statistical analysis of the recordings from each of the instruments showed that the observed bias was not significant and was negligible with respect to the scale of the instrument. All the points were within the limit of agreement.

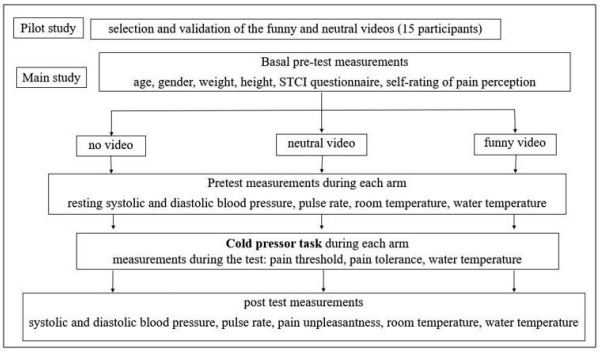

Figure 2. Study Protocol

A sample size of 25 was calculated using 80% power and 5% level of significance.[11] Young healthy Indian male volunteers between the age group of 18-35 years were recruited. Subjects with a history of acute or chronic illnesses, chronic smoking, tobacco chewing, calluses, irritant contact dermatitis and recent cuts or burns over the hand were excluded from the study. Subjects were requested to avoid caffeine, alcohol and analgesic/ antipyretic medications for a period of 12 hours before the experiment.[13,17,23,25] The experiment was performed at the laboratory, in the evening, at the same time of the day

on all participants. The subjects were requested to wear light comfortable clothes, avoid strenuous physical activity and consume a normal vegetarian meal 4 hours prior to the experiment. They were also asked to refrain from fatty foods, added salt intake and beverages for at least 12 hours before the experiment, as they are known to increase pain sensitivity soon after consumption.[15]

Basal measurements: Following written informed consent, age, gender, weight in kilograms (using weighing machine, TANITA), height in centimeters (using stadiometer) were noted. The subject's non-dominant hand was inspected for redness, dermatitis, calluses, cuts and burns. State-trait-cheerfulness inventory (STCI) scale was administered, and the subject's humour trait was categorized. The subject's perception of his own pain tolerance was rated on a Visual Analogue Scale of 1 to 10 by asking him to rate "how he perceives his own tolerance to pain".

Experimental arms: Following the basal measurements, each subject was exposed, in random order, to the three arms of the experiment - no video arm, funny video arm and neutral video arm - with a gap of at least 3 days between each arm. In the 'no video' arm of the study, the subject performed the cold pressor task with no distractions. In the remaining arms, the subject performed the cold pressor task while watching the neutral video (during the neutral video arm) or the funny video (during the funny video arm) chosen through the pilot study, on a screen placed in front of them.[11] The subject was informed that the experiment would involve pain and that they could withdraw from the study at any time.

Pretest measurements (performed during each arm): Subjects were instructed to empty their bladder, sit comfortably on a chair with a back rest, with feet on the ground and arm supported at the level of heart. Three resting blood pressure and pulse rate measurements were taken, and the deflated BP cuff was left around the arm. The room temperature was recorded using a digital recorder and water temperature using a laboratory thermometer.

Cold pressor task: The subject immersed his non-dominant hand up to 5 cm above the wrist into cold water in a container, palm down and fingers spread.[26,27] The laboratory thermometer was left in the water throughout the test to measure water temperature and the temperature was maintained between 8°C and 9°C by adding ice.[13,21,23,28] The water was intermittently stirred with a glass rod to dissipate the heat generated by the hand, as this could alter pain perception.[23] Two stop watches were started when the subject immersed his hand. He was instructed to say the word 'pain' when he first felt pain. At this point one of the stop watches was stopped and the time, in seconds, was noted as 'pain threshold'. The subject continued to immerse his hand in cold water until he was unable to tolerate pain, at which point, he removed his hand from the water. The second stopwatch was stopped at this point and the time, in seconds, was noted as 'pain tolerance'.

Post-test measurements (performed during each arm): Immediate post-test pulse rate, blood pressure, room temperature and water temperature were recorded as soon as the hand was removed from the cold water. Cardiovascular reactivity was assessed as the change in systolic blood pressure, diastolic blood pressure and pulse rate (Δ SBP, Δ DBP and Δ PR respectively), calculated as the difference between post-test and pre-test values. Pain unpleasantness was rated by the subjects, on a Visual Analogue Scale, between '0' (being 'no pain') and '10' (being the 'worst pain/most agonizing pain') experienced during the experiment (fig. 3).[23,25,29,30]

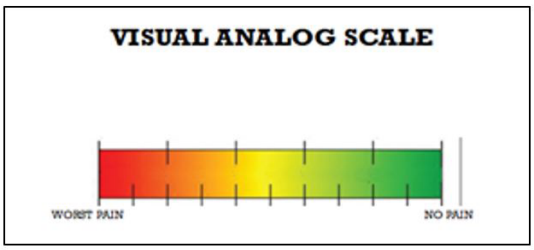

Figure 3. Pain unpleasantness (rating) scale

Data analysis was done with the R (version 3.6.1) software. Descriptive statistics were presented as mean ± standard deviation. A comparison of measures across the three arms of intervention was done using Repeated Measures ANOVA. Comparison of pre and post intervention measures, within each arm, was done using the paired T-test. The associations were studied using Pearson test for parametric data and Spearman test for non-parametric data. Pain parameters and cardiovascular responses across groups based on STCI scores were compared using Kruskal Wallis Test.

RESULTS

The baseline characteristics of the study subjects (n=25; m=25) showed a mean age of 21.19 ± 1.06 years, mean weight (Kg) of 70.49 ± 11.93, mean height (cm) of 172.14 ± 5.49 and mean BMI (Kg/m^2) of 23.74 ± 3.68. The STCI scores showed that 16 subjects belonged to 'trait cheerfulness', 5 of them to 'trait bad mood' and 4 to 'trait seriousness' (Table 1). Subjects perceived their own pain tolerance with a mean rating of 6.24 ± 1.53.

Table 1. Subject characteristics

Subject characteristics	Values*
Age (years)	21.19 ± 1.06
Weight (Kg)	70.49 ±11.93
Height (cm)	172.14 ±5.49
BMI(Kg/m^2)	23.74 ±3.68
STCI scale scores:	
No of subjects with Trait – cheerfulness	16
No of subjects with Trait – seriousness	4
No of subjects with Trait – bad mood	5
Subject's perception of his own pain tolerance (Rating between 1-10)	6.24±1.53

*Data represented as Mean ± Standard deviation.

Table 2. Temperatures

	Room Temperature Average Pre-Post (°C)	Water temperature Average Pre-Post (°C)	SBP* (mm Hg)	DBP* (mm Hg)	PR* (beats per minute)
No video	25.60 ±1.25	8	114.96 ±11.15	71.36 ±12.78	78.2 ±18.18
Funny video	25.55 ±1.26	8	114.6 ±6.92	68.32 ±9.12	76.4 ±17.34
Neutral video	25.41 ±1.43	8	114.12 ±9.94	69.92 ±9.91	74.12 ±15.93

*Data represented as mean ± standard deviation.

The pretest measurements namely room and water temperatures (°C), resting systolic blood pressure, diastolic blood pressure and pulse rate were not significantly different across the three arms of the study. Thus, the subjects performed the cold pressor task under similar resting states in all three arms (Table 2).

Table 3. Comparison of Pain sensitivity measures

	No Video*	Funny Video*	Neutral Video*	P Value
Pain Threshold	15.92 ±10.58	18.68 ±14.08	16.48 ±13.87	0.189
Pain Tolerance	79.60 ±95.77	84.16 ±85.69	77.40 ±77.88	0.526
Pain Rating	7.40 ±1.15	7.40 ±1.08	7.40 ±1.00	1

*Data represented as mean ± standard deviation.

Across the three arms of the study pain threshold, pain tolerance and pain unpleasantness were not significantly different. Thus, for the given age group of healthy individuals, under specific standard laboratory settings, the objective and subjective measurement of pain perception were unaffected despite distraction in the form of neutral and funny videos (Table 3).

There was a significant difference between the pre-test and post-test values of systolic pressure (p=0.009), diastolic pressure (p=0.037) and pulse rate (p=0.012) within the 'neutral video' arm. A similar significant difference was also noted within the 'funny video' arm (p=0.004 for systolic pressure, p=0.002 for diastolic pressure and p=0.003). The 'no video' arm did not show this difference. However, there was no significant difference in the cardiovascular responses across the three arms of the study (Table 4).

Pain unpleasantness measured as pain rating using VAS score showed a significant negative correlation with the resting systolic blood pressure (ρ=-0.054; p<0.01*) and with the resting diastolic blood pressure (ρ=-0.054; p<0.01*) in the 'no video' arm (Table 5). There was a negative correlation between delta diastolic blood pressure and pain threshold in the 'no video' arm (r=-0.53; p<0.01*) (fig. 4).

There was no significant difference in pain sensitivity and cardiovascular responses to cold pain among subjects belonging to the 3 traits determined by the STCI scale. The subject's self-perception of pain tolerance rated on a Visual Analogue Scale did not show any significant correlation with the objective measures of pain threshold and tolerance.

Table 4. Comparison of Cardiovascular Parameters across the three arms

	No video		Neutral video		Funny video	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
SBP(mm Hg)	114.96 ±11.15	119.04 ±10.63	114.12 ±9.94	119 ±9.64#	114.6 ±6.92	118.56 ±8.02#
DBP(mm Hg)	71.36 ±12.78	71.76 ±12.71	69.92 ±9.91	72.96 ±10.27*	68.32 ±9.12	72.52 ±10.91#
PR(beats per minute)	78.2 ±18.18	74.48 ±20.52	74.12 ±15.93	69.44 ±17.82*	76.4 ±17.34	72.32 ±18.60#

Data represented as Mean ± standard deviation.
* Significantly different from pre-test value, p value<0.05
# Significantly different from pre-test value, p value<0.01

Table 5. Relationship between Pain sensitivity, Resting Blood Pressure and Pulse Rate

	Pain Tolerance (r value)	Pain Threshold (r value)	Pain Rating (ρ value)
Resting SBP	0.13	-0.3	-0.54*
Resting DBP	0.26	-0.2	-0.53*
Resting Pulse Rate	-0.18	-0.25	-0.35

*p value < 0.01

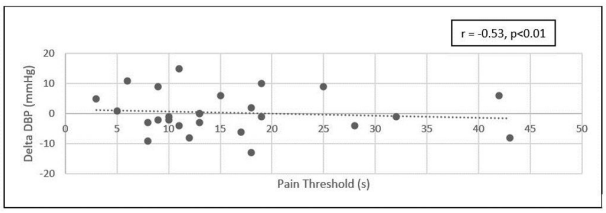

Figure 4. Association between Delta diastolic blood pressure and Pain Threshold in the 'no video' arm

DISCUSSION

Humour is a complex phenomenon with social, behavioural, emotional, psychophysiological and cognitive components.[31] Hence its effect on pain perception has proven to be varied. Some studies have attributed the effect specifically to humour, like the study by Cogan et al. that found pressure pain threshold to be higher in participants who had listened to humorous or relaxing audiotapes as compared to a dull narrative.[8] But a few studies have also shown that humour does not have a unique contribution to pain tolerance above and beyond the level of distraction.[11] Our study aimed to examine the effect of humour on objective and subjective pain measures among young healthy Indian males under controlled laboratory settings, with the use of a humorous video. The possibility of humour acting simply as a distraction was also explored with the use of neutral video for comparison. As the perceived 'funniness' of a video varies among individuals, we first validated the funniness of the videos with age and gender matched subjects. To explore the effect of individual variability on our chosen study design we captured two subjective components. First, we classified our subjects based on humor trait using the STCI scale, as the trait of an individual has been shown to influence the effect of distraction.[20] We then captured the 'self-perception of pain tolerance' of the subjects to examine its effect on the pain perception measures when exposed to painful stimuli.

The conclusion drawn from other studies, that humorous and neutral videos would affect pain threshold, tolerance and unpleasantness measures, was not supported by our data.[4,11,9,10] While mean values of pain threshold and tolerance were the highest in the funny video arm and lowest in the no video arm, the differences were not significant. A comparison of cardiovascular responses namely blood pressure and pulse rate across the three arms also showed no significant difference. It must be noted that, according to the STCI scale, most of our subjects belonged to the trait cheerfulness (n=16) with a few of trait bad mood (n=5) and trait seriousness (n=4). The mean values of pain sensitivity measures in each arm of the study may have been largely influenced by the dominant humour trait of the study population, which was cheerful. There was no effect of an added humor distraction on subjects with the cheerful trait, thus displaying no significant difference in their pain sensitivity across the arms. This incidental finding is supported by previous studies that have found that individuals with high humor traits coped well with pain, with or without the assistance of an induced humor state. Those with trait cheerfulness may be capable of staying cheerful without needing the stimulus of a humorous video.[21,22,31,32] Another factor that may have influenced the subjects' response to the humorous and neutral videos is the absence of the option of choosing the videos. Studies have concluded that preference may influence the effect of humour on pain sensitivity.[33,28] For this study we chose to standardize the stimuli given to the subjects through a pilot. Had the subjects been given the option to choose the videos, the effect may have been more pronounced.

The 'funny video' and 'neutral video' arm showed a significant increase in post-test systolic and diastolic blood pressures and decrease in pulse rate. The increased blood pressure could be the result of increased sympathetic stimulation caused by hand immersion in ice cold water. Sympathetic stimulation leads to increased arteriolar constriction and cardiac contractility in turn causing increased cardiac output. This was recorded as an increased post-test systolic blood pressure. Increased peripheral resistance caused by sympathetic stimulation led to increased diastolic blood pressure.[34-38] The 'no video' arm did have a difference in blood pressure and pulse rate values before and after the cold pressor task but not to significant levels.

We examined the data for correlations, which revealed that pain unpleasantness showed a significant negative correlation with resting blood pressure. There was also a negative correlation between delta diastolic blood pressure and pain threshold. These findings are consistent with those from other studies, which have proven that hypoalgesia is associated with higher resting blood pressure, with endogenous opioid release as the probable underlying mechanism.[39] An absence of correlation between the subjects' self-perception of pain tolerance and their objective measures of pain sensitivity must also be noted. The subjects' expectation of their pain tolerance did not match their actual ability to tolerate pain.

Our study explored the effect of humour on pain perception on subjects within a narrow age group of young healthy adult males. Hence generalisability of the findings to a larger age group and other genders under natural settings is not possible. Some confounders of pain sensitivity were not measured, like habitual levels of physical activity (with physical activity questionnaire) and anxiety levels (with anxiety scores).

The present study being a pilot study, forms the basis for future studies with larger sample sizes and wider age groups to compare between genders, BMI ranges and other components of humour. This would also allow the study of influence of other factors associated with pain sensitivity in the Indian scenario.

CONCLUSION

Exposure to humour and distraction during cold pain exposure had no effect on objective or subjective pain perception measures. It had no effect on cardiovascular responses to cold pain exposure across arms. There was a significant difference between the pre and post values of cardiovascular measures in the neutral and funny video arms. Subjective pain perception (pain rating) had a negative correlation with resting systolic and diastolic blood pressure in the 'no video' arm. The pain threshold showed negative correlation with diastolic blood pressure in the 'no video' arm. The humour trait and subject's self-perception of pain tolerance had no effect on both pain sensitivity and cardiovascular responses to cold pain.

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