

Effects of Short-term Cigarette Smoking on Response Times

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Abstract

Background: Cigarette smoking is a complicated, psychic, motor and pharmacological act. Cigarette has been reported to contain 500 agents, out of which nicotine present in the tobacco smoking has been thought to be the most offending one. Many of the pharmacological effects of nicotine are known to be the result of complex interactions at different levels of the central nervous system. But damaging effects only become measurable several years or even decades after the start of smoking. Therefore study is required to know the effects of short term cigarette smoking on cognitive performances which can be measured in terms of response times. **Objectives:** 1. To study the response times to visual, auditory and cutaneous stimuli in short term cigarette smokers, 2. To study the immediate effect of smoking of one cigarette among smokers on response times. **Material and Methods:** Thirty male healthy cigarette smokers of age group 20-30 years, drawn from population of Hubli were studied for visual, auditory and cutaneous response times. The results were compared with equal number of age and sex-matched controls. Response times were measured by an instrument called Response analyser. **Results:** 1. The difference in the response times between control group and short smoker group, (before smoking) is not statistically significant, 2. Among smokers, smoking a cigarette significantly [statistically] shortens response times, 3. The response times after smoking a cigarette, are also significantly [statistically] shorter than the control values. **Conclusion:** 1) Although response times are shorter in the smokers before smoking than control subjects, the difference is not statistically significant, 2) However, immediately after smoking a cigarette, the response times (R.T) are significantly shortened among smokers.

Keywords: Response times; Visual stimulus; Auditory stimulus; Cutaneous stimulus; Short term Cigarette smokers; Nicotine; cognitive function.

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Introduction

Tobacco causes more than 8 millions deaths each year. Of which 7 million of deaths are due to smoking and around 1.2 million are as a result of non-smokers being exposed to second hand smoke. Cigarette smoking has drawn world-wide attention and has become a worrying public health problem. Smoking remains one of the great challenges to the field

of public health in all countries of the world. Its association with several debilitating and often terminal diseases has been widely studied. In spite of well-known hazards of smoking to health, recent surveys have indicated that most people who smoke tobacco start during their teenage years or as a young adult. Cigarette smoking continues to be common among the youth who constitute a majority of our population. According to recent available estimates, tobacco smoking kills at least 3 million people each year world wide.^[1]

Some investigations into the relationship between cigarette smoking and cognitive performance, have reported that smoking facilitates performance, concentration and relieves anxiety and tension, but other researches have come with the opposite conclusions. Long term effects of chronic cigarette smoking have been studied already and Cognitive impairments have been found in them. Variations in results may be due to differences among studies in design and also to differences in task demands.^[2] The effect of cigarette smoking on cognition, therefore, has not been well established across a wide range of task demands. Many of the current neurological hypotheses of tobacco smoking concern relationships between nicotine-induced neurotransmitter alterations at the level of the individual neuron and mental behavioral states.^[3] Thus effects of cigarette smoking on the central nervous system are of the most interesting in understanding why people smoke. Therefore it is required to study the co-relationship between short term cigarette smoking and cognitive performances in terms of response times.

Response time is defined as “the time taken by an individual to respond to an external stimulus or a situation” or response time is “an interval between the application of the stimulus and the objective response to it” or “it is the time taken by an individual to perform some definite motor act after receiving a stimulus signal.”^[4-9] A significant reduction in the response time indicates an improved sensorimotor performance and an enhanced processing ability of the central nervous system.^[10]

Material and Methods

The present study was conducted on volunteers comprising thirty apparently healthy male cigarette smokers of age-group twenty to thirty years and equal number of healthy age and sex matched non-smoker controls, drawn from population of Hubli, Karnataka state. Duration of smoking was in the range of one to five years and cigarettes being smoked were in the range of four to twenty cigarettes daily. In this study, a smoker is defined as one who had smoked one or more cigarettes daily for at least one year and a Non-smoker is defined as one who had never smoked cigarettes at all so far. Ethical committee clearance was obtained referenced by order no: ECR/486/Inst/KA/2013/RR-16 dated 15th and 16th November 2018. All subjects were right-handed, non-alcoholics, non-tobacco products chewers, took no drugs and had a uniform pattern of diet and activity. None were involved in any athletic training or exercise programmes. They had clinically normal hearing, vision and cutaneous sensations and were absolutely sound physically and mentally. Their history and thorough clinical examination did not reveal abnormality of any system.

Smoking history was recorded in detail in terms of

1. Number of cigarettes being smoked daily
2. Duration of smoking in years.
3. Number of puffs and time taken for smoking of each cigarette.
4. Name of cigarette brand being used.
5. Reasons for onset of smoking and for still continuation of smoking.
6. Whether cigarette smoking has been left at any time, since its onset.

On the day before the study smokers were instructed to refrain from smoking at least two hours prior to the study of tests to avoid residual effect of their last smoking dose. Acute

effects of smoking on response time measurements were again determined in smokers, immediately after smoking one small sized cigarette of length 69mm.

Subjects were briefed about the study protocol and informed consent was obtained from them before taking part. This study was performed between forenoon session in the physiology department KIMS Hubli. Subjects were divided into batches, each batch consisting of four subjects and response time measurements were carried out, after the subjects were thoroughly acquainted with the working of the corresponding instruments, Response Analyzer.

Response Time Measurements

Visual, Auditory and Cutaneous response times were measured by using Response Analyser "manufactured by 'Yantrashilpa' electronics- 0101 PUNE[YSRT-0101]. This instrument works with working supply of 10V.DC and is equipped with a very sensitive quartz clock which can measure up to 1/10 th of millisecond. Display accuracy of the instrument is ± 0.001 sec and display range is 9.999sec maximum.

It is a Micro- processor based system that can be programmed to measure the response time of the subject to various sensory stimuli, e.g., vision, sound, touch, electrical etc. Different programmes are used for producing light, auditory and cutaneous stimuli. Subjects are instructed to press a response micro switch [thumb switch] as quickly as possible, after the presentation of stimuli but never before i.e. prematurely, with thumb finger of each hand separately and alternatively when light, sound, touch etc. stimuli are presented to them. The time of occurrence of stimuli can be varied with the help of the timer setting. The intensity of stimuli is kept constant for all the subjects.

The auto display unit counts the time elapsed between the presentation of the stimulus and response to it in milliseconds. To start with, auto display unit shows 0000 milliseconds. The counting in milliseconds continues till the subject presses the thumb switch [response switch] which he does the instant he sees /hears/touches the stimulus. At the press of the response of the switch, the program stops counting and the response time is shown on the Light -Emitting Diode [L.E.D] display unit. This response time is noted and taken down as the response time for that stimulus, as the case may be.

Response Time Measurement Tests

Numerous response time tests have been devised to examine a person's alertness or promptness of response.^[6]

In our setup, following response time tests were carried out by utilizing 'Response Time Analyzer'.

Before measuring response times, each subject had been made familiar with response time apparatus 'Response Analyzer' and the subjects were given detailed instructions regarding the experimental procedures employed for each test to alleviate any fear or apprehension. Subjects were asked to sit comfortably on a chair and allowed to take 15- 20 minutes rest before beginning the actual procedure.

For each test, sufficient practical trials were administered to each subject until we were satisfied that the subjects understood and performed the tests as required. Thereafter, actual record of readings were being made for that particular test. Subjects were asked to press the response switch by using either of the hands alternatively.^[7,8]

In all the tests, most parameters were kept as constant and as possible viz., time, instructions and familiarity of performance, etc. On occasions when more subjects were available, the tests were performed by one subject while others were being asked to observe him performing the test.

A partition was provided between the subject and examiner so that the subject responds only to the stimulus and not by seeing inadvertently to examiner's actuation of "start" switch.

Experimental room was curtained all around to reduce background illumination which is helpful particularly for the visual response test.

Visual response time [VRT]. Auditory response time [ART] and cutaneous response time [CRT] were measured in order in the quiet secluded room whose ambient temperature was about 27 °C, forenoon session. Thumbs of right and left hands of each subject were being used alternatively to press a response switch to get reading for that particular hand and for that particular test.

Before taking each reading in all the tests, subjects were being taken mentally alert by telling them, "Are you ready?". After some seconds, stimulus was made to arrive by pressing the 'start' switch.

This was to avoid possible distractibility in human volunteer. Time of occurrence of stimuli was being changed as and when during the performance of all the tests with the help of timer setting, so that subjects were not getting clues when stimuli will be presented to them. This was done to keep the subjects more attentive and to get more reliable response time readings.

1. Visual Response Test

This test measures the response to a visual [light] stimulus. The 'visual' mode was selected and mode indicator was switched on. Visual stimulus was given from front. Depending on the timer setting. When 'start' switch was pressed, the bulbs used to glow. Subjects were asked to get ready and to press the response switch quickly as soon as glowing of bulbs was noticed. Then autodisplay indicated the response time in milliseconds elapsed between the start of visual stimulus and the response to it.

2. Auditory Response Test

This test measures the response to a sound [auditory] stimulus. The 'audio' mode was selected and mode indicator was switched on. Sound signal was given from front. The 'start' switch was pressed. Subjects reacted promptly to the auditory signal by pressing to vary the time of occurrence of sound stimulus presented to the subjects. The reading on the display indicated 'response time' to the audio stimulus in milliseconds.

3. Cutaneous Response Test

This test measures the response to a cutaneous [touch] stimulus. Cutaneous mode was selected. Here the stimulus was contact between the plunger and the skin. Subjects were asked to press the response switch as soon as the touch sensation was felt when one hand was put over the plunger. The reading on the display indicated response time to the cutaneous stimulus in milliseconds.

Results

Right Hand Response Times

Table 1: Right Hand Least Values.

Parameters	Control subjects [C] [Mean ± S.D.]	Smokers before smoking [S1] [Mean ± S.D.]	Smokers immediately after smoking [S2] [Mean ± S.D.]
VRT (RL)	189.8 ± 4.90 m.sec	188.4 ± 4.28 m.sec	178.96 ± 3.25 m.sec
ART (RL)	165.86 ± 2.72 m.sec	165.77 ± 2.26 m.sec	155.82 ± 2.56 m.sec
CRT (RL)	195.83 ± 3.56 m.sec	194.27 ± 2.92 m.sec	186.98 ± 2.68 m.sec

These are readings that is least values from 10 readings that are taken from each subject

Table 2: Right Hand Average Values.

Parameters	Control subjects [C] [Mean \pm S.D.]	Smokers before smoking [S1] [Mean \pm S,D,]	Smokers immediatelyafter smoking [S2] [Mean \pm S.D.]
VRT	203.18 \pm 2.87m.sec	200.67 \pm 1.92 m.sec	191.3 \pm 4.86 m.sec
ART	185.42 \pm 1.83 m.sec	185.06 \pm 1.25 m.sec	174.9 \pm 1.38 m.sec
CRT	208.3 \pm 1.76 m.sec	206.22 \pm 1.67 m.sec	197.46 \pm 1.27 m.sec

These are readings that is average values from 10 readings that are taken from each subject. The difference in the least and average value for right hand response times are not great. They show a common pattern.

Table 3: Left Hand Least Values.

Parameters	Control subjects [C] [Mean \pm S.D.]	Smokers before smoking [S1] [Mean \pm S,D,]	Smokers immediately after smoking [S2] [Mean \pm S.D.]
VRT	191.13 \pm 5.50m.sec	190 \pm 3.50 m.sec	185.4 \pm 2.96 m.sec
ART	167.23 \pm 3.5 m.sec	167 \pm 3.86 m.sec	162.27 \pm 2.78 m.sec
CRT	196.56 \pm 2.69 m.sec	194 \pm 3.02 m.sec	189.88 \pm 2.06 m.sec

Table 4: Left Hand Average Values.

Parameters	Control subjects [C] [Mean \pm S.D.]	Smokers before smoking [S1] [Mean \pm S,D,]	Smokers immediately after smoking [S2] [Mean \pm S.D.]
VRT	203.34 \pm 2.65m.sec	201.42 \pm 1.90 m.sec	196.28 \pm 1.92 m.sec
ART	185.62 \pm 1.85 m.sec	185.46 \pm 1.87 m.sec	180.54 \pm 1.67 m.sec
CRT	209.34 \pm 2.37 m.sec	207.24 \pm 2.39 m.sec	202.68 \pm 2.46 m.sec

Statistical analysis done using students paired t test among smokers, unpaired t test among controls and before smoking in subjects.

In general, the left-hand response time were slightly longer, compared to right hand response times, the difference being statistically insignificant. The response times (least values and average values) in either hand show a common pattern. That is:

1. The difference in the response times between control group and short smoker group, (before smoking) is not statistically significant.
2. Among smokers, smoking a cigarette significantly [statistically] shortens response times.
3. The response times after smoking a cigarette, are also significantly [statistically] shorter than the control values.

Discussion

Response time measurements

According to a study conducted by Aditya Lal Vallath et al they found significant improvement in the visual and auditory reaction times immediately after smoking a cigarette. However they also mention that this beneficial effect is short lived and the reaction time actually prolonged 12 hours after the smoking episode. This opinion suggests the transient nature of cigarette smoking and also deleterious effect in the long time [2015].^[11]

Visual response times (VRT) and Auditory response times (ART), obtained for age and sex matched controls in this study correspond well with the values, observed by most other workers. However, cutaneous response time (CRT) has not been discussed so widely.

Pathaket al (1964) and Dixit et al (1955) reported that cutaneous response time ranges from 115 – 190 m.sec and the Visual response time somewhat longer than cutaneous response time. In the present study, CRT ranges from 195-209 m.sec.^[12] The observed difference in response times may be because of different methodology involved in it's measurement.

There is no influence of using either hand in right-handed person on response time. This is in accordance with the earlier study of Sathiamoorthy et al (1994).^[13]

In the control group, auditory response times are shorter than Visual response times. These findings are in agreement with that of most other workers including the present study. However, Dhangaure et al (1994) and Mehrotra et al (1986) obtained higher ART values than VRT values in their study.^[9,14] Among smokers also, the ART are shorter than VRT and this is consistent with the report made by Ichatoria et al (1991).^[15] Visual stimuli are less able to activate alerting mechanisms automatically than are auditory stimuli. The auditory stimulus appears to involve changes more easily in the rate of alertness at which the central processing system can interrogate sensory – memory pathways. Visual intensity effects are primarily decreased alertness. These EEG changes written in the direction of normal pattern when subjects were allowed to smoke two cigarettes. Pritchard et al (1992) suggested that response time (R.T) is faster in the smoking session than in non-smoking session. George Spilich (1992) suggested that variance in results may be due to differences among studies in design and also to differences in task demands.^[16,17]

In the present study we used simple rapid response time tasks, therefore, our observation is in consensus with the observations of all the previous studies. Hence response times measurements provide a suitable, convenient test based on simple task for psychophysiological effects of compounds present in the cigarette smoke affecting the central nervous system and can be recommended for studying changes in motor and psychic functions.

Though response time values are less in smokers and immediately smoking a cigarette, it appears that the central processing is fast among smokers. However cigarette smoking bad effects on the overall health of the body have been reported. This has to be kept under consideration.

Conclusion

Thirty male healthy cigarette smokers of age group 20-30 years, drawn from motivated students group of population of Karnataka Medical College Hubli were studied for visual, auditory and cutaneous response time measurements and were also screened for cardiovascular autonomic dysfunction. The results compared with equal number of age and sex-matched controls. Although response times are shorter in smokers before smoking than control subjects, the difference is not statistically significant.

However, immediately after smoking a cigarette, the response times [R.T] are significantly [statistically] shortened. In smokers, nicotine has transient effect of stimulation on central nervous system immediately after smoking cigarette. But it's effect [stimulating] is not long lasting [wears off about 2 hours after the last smoking episode]. Response time measurements used in this study involve simple, rapid motor tasks. However, one study conducted [1992] on the performance of complex- tasks, reported that cigarette smoking impairs performance of complex motor tasks. In the light of this observation, it can be said that beneficial effects of smoking on motor performance are limited only to the simple motor tasks.

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