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ALTERATIONS IN HUMAN REACTION TIME UPON CONSUMPTION OF TAURINE-CAFFEINE BASED ENERGY DRINK. A GENDER BASED STUDY

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ABSTRACT:

Background: Energy drinks contains several potentially psychoactive ingredients including taurine, glucuronolactone, and caffeine that increases the human performances, reaction time and mood with relative differences to visual and auditory stimuli between both the genders.

Objective: we aim to evaluate and compare the effects of energy drink on reaction time of male and female subjects upon visual cue, auditory cue and tactile cue.

Methods: The study was conducted on 50 healthy individuals of age group 18-25, residing in Karachi, Pakistan. Ruler Catching Method was used to calculate the reaction time on auditory visual and tactile cues and formula $t = \sqrt{d/490}$ was applied to calculate the reaction time in cm/sec².

Results: It was analysed that the mean reaction time for all visual, auditory and tactile cues decreased significantly after the consumption of the energy drink. However, visual response after consumption of energy drink was quicker in males whereas, auditory and tactile responses were faster in females.

Conclusion: Consumption of energy drinks surely influence the visual, auditory and tactile responses positively in both the genders but on the other hand also poses vulnerable impact on human health.

INTRODUCTION: Energy drinks are soft drinks advertised as boosting energy which consists of common ingredients like methylxanthines (including caffeine), B vitamins, carbonated water, guarana, yerba mate, taurine, ginseng, maltodextrin, inositol, carnitine, creatine, glucuronolactone, sucralose and ginkgo biloba [1]. Energy drinks contains several potentially psychoactive ingredients including taurine, glucuronolactone, and caffeine. Ginseng present in energy drinks add to the stimulant effects of caffeine [2]. During the last decades, that is around 1989 after the revolution, the energy drinks and caffeine consumption was increased dramatically in young students and teenagers among both the genders. Accordingly, approximately 66% of the consumers are between 13 and 35 years of age, with males consuming 65% of the energy drinks approximately in the market [3]. The reason for increased usage of energy drinks is associated with a positive influence on upper body muscle coordination [4]. Moreover, excessive consumption of energy drinks may lead to a minimal

state of euphoria owing to stimulant properties of caffeine and may also induce agitation, anxiety, irritability and insomnia [5, 6]. Several researchers have investigated that human performances, reaction time and mood enhancement results positively from the use of energy drinks when assessed separately and combined with caffeine. It is also stated on the energy drink cans that it increases the concentration and reaction time speed. Reaction time is simply defined as the time required by an observer to detect the presence of a stimulus [7]. Reaction time basically represents the neuromuscular coordination level of the body through different mechanical, chemical and physical processes. These processes in turn decodes visual, auditory or tactile stimuli which travel via different afferent pathways and reach the brain as sensory stimuli [7]. Reaction time is dependent on several factors like arrival of the stimulus at the sensory organ, conversion of the stimulus by the sensory organ to a neural signal, neural transmissions and processing, muscular activation, soft tissue compliance, and the selection of

an external measurement parameter [8]. However, there are relative differences between the reaction time to visual and auditory stimuli between both the genders [7]. **Thereby, we aim to evaluate and compare the effects of energy drink on reaction time of male and female subjects upon visual cue, auditory cue and tactile cue.**

Materials and Methods

The study was conducted on 50 subjects (25 males and 25 females) of 18-25 age group. They were all the residents of Karachi, Pakistan, and were not suffering from any pathological condition at the time of sampling. Ruler Catching Method was used to calculate the reaction time on auditory visual and tactile cues and following formula was applied to calculate the reaction time in cm/sec².

$$t = \sqrt{d / 490}$$

Where,

T= time for the reaction

D= Distance

For visual response

The individual sits in the chair with their dominant arm over the edge. The lower end of 12 inch ruler was placed at the subject’s index finger, while experimenter holds the upper end, ruler is dropped and subject catches the slipping ruler with index finger and thumb, the reading is read off from ruler. The experiment was repeated thrice and values were put in the formula to calculate the reaction time.

For auditory response

The individual sits in the chair with their dominant arm over the edge. The lower end of 12 inch ruler was placed at the subject’s index finger, while experimenter holds the upper end, ruler is dropped and auditory bell is rang. At the same time, subject catches the slipping ruler with index finger and thumb upon hearing the bell, the reading is read off from ruler. The experiment was repeated thrice. After which the values were put in the formula to calculate the reaction time.

For tactile response

The individual sits in the chair with their dominant arm over the edge. The lower end of 12 inch ruler was placed at the subject’s index finger, while experimenter holds the upper end, ruler is dropped and subject is hit gently from the back on non-dominant arm. At the same time, subject catches the slipping ruler with index finger and thumb upon hitting, the reading is read off

from ruler. The experiment was repeated thrice and values were put in the formula to calculate the reaction time.

Results

After the analysis, results indicate that the mean reaction time for all visual, auditory and tactile cues decreased significantly after the consumption of the energy drink, as shown in table 1.

	mean time before consuming energy drink	mean time after consuming energy drink
Visual Cue		
male	0.19±0.02	0.17±0.02
female	0.21±0.02	0.18±0.02
Auditory Cue		
male	0.20±0.03	0.19±0.03
female	0.20±0.02	0.17±0.04
Tactile Cue		
male	0.17±0.03	0.14±0.04
female	0.14±0.03	0.12±0.04

Table 1: Mean reaction time upon visual, auditory and tactile cue before and after the consumption of energy drink

However, according to the table 1, the mean reaction time for visual cue after consumption was higher in females than males, whereas, reaction time for both auditory and tactile cues were high in males than in females.

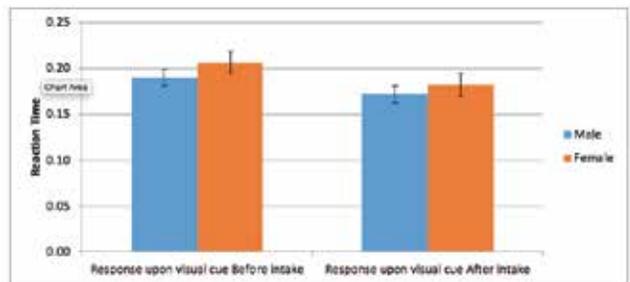


Figure 1: Reaction time upon visual cue before and after the consumption of energy drink

Figure 1 shows that the males responded faster to visual cue. However, before the consumption of energy drink males were found to respond faster which might be because of physiological and anatomical differences in both genders, together with diet, life style, age and environmental factors.

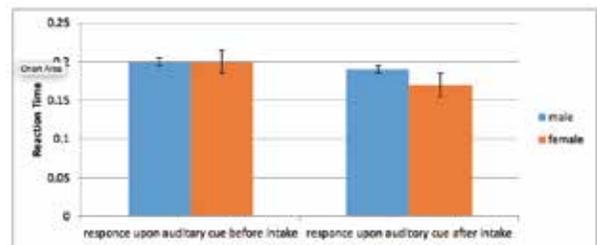


Figure 2: Reaction time upon auditory cue before and after the consumption of energy drink

Fig 2 showed that comparison between male and female responses to auditory cue, before and after the intake of energy drink. Before the intake of energy drink male and female reaction time were equal. However, it was found that after the intake of energy drink females had faster reaction time than males may be due to life style changes, time management skills and power of sensing auditory sensation.

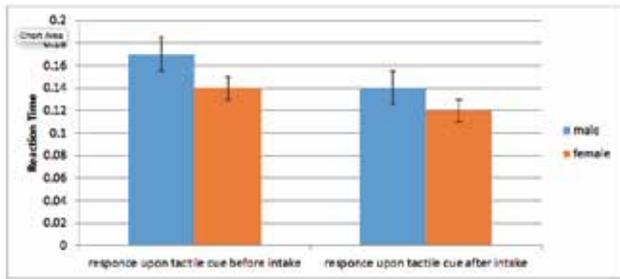


Figure 3: Reaction time upon tactile cue before and after the consumption of energy drink

According to figure 3, it was analysed that on tactile cue before and after the intake of energy drink females had faster reaction time than males. Males took more time to respond on touch stimulus, while females responded in lesser time. It is because of that females have thin dermis that sense any stimulus we apply easily as compare to male subject. It can also be stated that intake of energy drink influence the tactile responses of both the genders positively.

Discussion

Energy drinks are a group of drinks used to provide an extra energy boost thereby, maintain alertness, promote wakefulness in addition it also provide mood and cognitive enhancement [9]. More than hundreds of researches are reviewed by the scientists about the consumption of moderate amount of caffeine that results in effects like increase in availability of energy, decreased general and mental fatigue, increase in the motor, cognitive and physical performance, increased wakefulness and alertness, faster and accurate reactions, increased ability to concentrate, solve problems, make decisions and enhanced short-term memory with increased neuromuscular coordination [10-13]. It was also reported that ingestion of 40mg of caffeine for half an hour increases the ability of motor responses to correctly match the visual stimuli. This effect is due to the association of increased event-related potentials in brain regions involved in visual processing, decision-making, and the application

of selective attention [11]. In the present study, it was found that the reaction time decreases after the consumption of the energy drink in both the genders resulting in faster response. However, it was much pronounced in males than in females. Supporting our results, authors also reported that male athletes respond faster as compared with female athletes to visual stimuli, which involved gross motor movement [14]. This is because the energy drink have stimulant effect on central nervous system which alert the brain and brain respond more quickly. It has been reported that males tend to have larger brain volume [15-17] contributing to the cause of the observed difference.

The consumption of energy drink also decreases the reaction time for auditory cue for both the genders but now the effect is more pronounced in females in comparison to males. This reduction effect is mainly attributed to the caffeine content of the energy drinks as identified through other studies that caffeine is the main influencer of cognitive abilities including simple reaction time in humans. Also the sugar content increases the effect as the high sugar level increases acetylcholine precursor named Acetyl CoA that is the main stimulant of both peripheral and central nervous system, which influences the response initiation to a stimulus and its reaction time [18-20]. According to our results, reaction time due to tactile cue was also decreased after the intake of energy drink in both the genders. However, the effect was much faster in females as compared to males. Males took more time to respond on touch stimulus, while females responded in lesser time mainly because females have thin dermis that sense any stimulus we apply easily as compare to males who have thick dermis and need more time to sense and transfer the stimulus. In addition, caffeine also have effects on endurance of muscles [21, 22].

Conclusion

In this study, it was observed that energy drinks have stimulant effect on human body. However, the long term effects of energy drink consumption can have vulnerable effects that include hypotension, edema, palpitations, tachycardia, headache, insomnia, amenorrhea, fever, euphoria and neonatal death. In addition, development of obesity and insulin resistance due to long term sugar exposure which is the main component of energy drinks [23]. So, a regular use of such energy drinks can definitely deliver short time benefits, but in long term they can impact the health of the consumer adversely and can make them prone to various physiological disorders.

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Author's contribution:

Asif Abbasi; data collection, data analysis, manuscript writing, manuscript review

Amaila Fazal; data analysis, manuscript writing, manuscript review

Faizan Mirza; manuscript writing, manuscript review

Sadaf Ahmed; manuscript writing, manuscript review