

## Behavioral, performance and cortisol alteration of quail chicks exposed to mobile phone radiation..

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**ABSTRACT:** This experiment aimed to evaluation of the effect of radiation emitted from A third generation Huawei mobile phones (900 MHz radiofrequency) on the behavioral; performance and cortisol changes of quail. A total of 135 one day old age Japanese quail chicks which divided in to three group as control group without any phone exposure (n=45) and second group were exposed to mobile phone radiation (n= 90) which at all age (during and post hatching) or post hatching only, The obtained result, illustrated that, the phone radiation leading to a significant increase in resting, standing and cortisol level with a significant decrease in feeding; preening ,exploratory behavior, feed intake, body weight and body weight gain all of this reflect an a stress factor depending on the time for exposure.

**KEYWORDS:** mobile phone radiation, phone and performance, behavior and stress

### 1. Introduction

Smartphones have introduced a new dimension to our lives. We found ourselves engaged with our mobile than talking to the person around us. Parents give their mobiles to their children to play with instead of traditional toys. when preparing for a trip, ensuring the mobile charger is packed has become essential , Children and teenagers are spending more time playing with devices than they are playing outdoors.. However, are we aware of the potential health risks associated with excessive smart phone use [1] Electromagnetic radiation is a typically unrecognized and often ignored form of environmental pollution. It can be broadly categorized into ionizing and non-ionizing radiation based on its frequency range in the electromagnetic spectrum. Ionizing radiation has a higher frequency and greater penetration power, which can pose significant health risks, including genetic disorders and neurological issues. In contrast, non-ionizing radiation has a shorter frequency range; however, long-term exposure to this type of radiation can also have serious consequences

for human health. These effects may include skin tissue damage, alterations in sleep cycles, behavioral changes, and even carcinogenic effects [2] The increased prevalence of cell phone usage has raised concerns about the safety of operators exposed to non-ionizing electromagnetic radiation (EMR) in the ultra-high frequency range of 300-3000 MHz. Kaya et al.,[3] Studies on various animals and humans have shown that radiation emitted by cell phones and base stations negatively impacts different organs and tissues in the body. [4]

### 2. Materials and Methods

#### 2.1. Ethical approval

The present research was carried out in accordance with the Animal Care and Use Committee guidelines of the Assuit University, Egypt, ethical number 04-2024-100240. The hatching eggs and quails in this study were given proper care and management without causing them any unnecessary distress.

## 2.2. Experimental design

This experiment aimed to evaluate the effect of mobile phone radiation on behavior, performance, and some blood parameters of quail which done as:- 135 one- day-old chicks divided in to three groups each of them 45 quails (15 and three replicate) as, Control group without mobile phone at all (pre or after hatching) , Control mobile group exposure to mobile phone after hatching and Mobile group at all (pre or after hatching) which exposure to (3G) device Huawei GR5 mobile phone and they were also connected to Wi-Fi and were called every 3 hours for 1 minute (about 4 times) daily, from one to 35 day old age.

**2.3 Management and rearing facilities during brooding of chicks:** The housing environment was stabilized prior to the arrival of the quail chicks. A continuous lighting program was implemented, with 23 hours of light and 1 hour of darkness. A 60-watt bulb was suspended at a height of 2.20 meters, which is at the head level of the birds. The light intensity at the level of the birds was approximately 2.66 lux/m<sup>2</sup>/second. During the first week of brooding, the temperature was maintained at around 35°C using an electric heater. This temperature was then gradually reduced by 2.8°C per week until the chicks were fully feathered, which typically occurs at about 3 to 4 weeks. The temperature was monitored using a thermometer at the level of the chicks' backs. Ambient temperature was recorded with a maximum and minimum thermometer, and the average relative humidity ranged between 60% and 70%. The chicks were given a starter quail diet with 28% crude protein, as recommended by the National Research Council (NRC, 1994). Feed was provided in trough feeders (plastic trays), allowing for 2-3 cm of feeder space per chick. Water was available at all times in plastic drinkers with a 4-liter capacity. During the first week, poultry drinking fountains were used and filled with marbles or clean small gravel to prevent the quail chicks from entering the water, thus minimizing the

risk of drowning and chilling, which can lead to a high percentage of deaths during the brooding period.[5].

## 2.3. Studying parameters:

### 2.3.1. Quail behavioral pattern

Observations were conducted using instantaneous scanning according to Mahmoud et al.,[6], three times a day: early morning (7:00-8:00 a.m.), late morning (10:00-11:00 a.m.), and late afternoon (4:00-5:00 p.m.) over the course of three days each week. The following behaviors were recorded based on a behavioral ethogram:Table 1

### 2.3.2. Quail Performance .(El Shoukary et al.,[7])

- 1. Live body weight (LBW):-**The chicks were weighed weekly during the entire experimental period. 1 to 35 days of age (using Sartorius balance produced by Sartorius– universal, made in Germany). Individual live body weights were totaled and divided by the number of experimented chicks to obtain the average live body weight (LBW). All birds were weighed to the nearest 0.1g.
- 2. Body weight gain (BWG):-**The average weekly live body weight gain was calculated by subtracting each chick's initial live weight from its final weight at the end of the week. The total weight gains for all individual chicks were then summed and divided by the number of chicks in the experiment to determine the average live body weight gain (BWG).
- 3. Feed intake (FI):** Chicks in each replicate were given a specific amount of feed each week. At the end of the week, the remaining feed was measured, and the amount consumed was calculated by finding the difference. The following equation was used to determine the average feed consumption.

$$\text{Feed intake (gm/bird)} = \frac{\text{Amount of feed consumed}}{\text{Number of chicks}}$$

- 4. Feed conversion (FCR)**Feed conversion (feed required to produce a unit of gain) was calculated for

each age interval by dividing the average feed consumption per chick per week on average body weight gain per chick per week.

#### 2.4. Histopathological studies

For histopathological evaluation, specimens were fixed in a 10% buffered formaldehyde solution and embedded in paraffin. Next, 5 µm-thick sections were cut from the paraffin blocks. All cross-sections were stained with hematoxylin and eosin, approximately 10 slides per specimen were studied. They were examined under the light microscope by a single pathologist blinded to the study. The tissue reactions were evaluated in all samples. [8]

##### 2.4.1. Statistical analysis

Data were tested for distribution normality and homogeneity of variance. Data were reported as means and standard error and analyzed by one-way ANOVA with statistical package SPSS. The significance of difference among the different light groups was evaluated by Duncan test. The significance level was set at  $P \leq 0.05$

### 3. Result

**Table 1:** Effect of phone radiation on some behavioral pattern percentage:

Parameters	Control (no mobile)	Control mobile (post hatching)	Mobile radiation (pre and post hatching)	P-Value
<b>Movement activity or Kinetic behavior</b>				
Walk and running	0.25 <sup>a,b</sup>	.1817 <sup>b</sup>	.2989 <sup>a</sup>	.052
<b>inactive behavior</b>				
Standing	.1699 <sup>b</sup>	.1389 <sup>b</sup>	.3039.04976 <sup>a</sup>	.005
Resting behavior	.1312 <sup>b</sup>	.2734 <sup>a</sup>	.1741±.04255 <sup>a,b</sup>	.045
<b>Ingestive or feeding behavior</b>				
Drinking	.1090	.1043	.1152	.931
feeding	.1227 <sup>a</sup>	.0967±.01383 <sup>a,b</sup>	.0760±.02001 <sup>b</sup>	.106
<b>Maintenance behavior</b>				
Preening	.0756 <sup>a</sup>	.0816 <sup>a</sup>	.0294 <sup>b</sup>	.026
<b>Exploratory behavior</b>				
Non aggressive pecking	.0453 <sup>a</sup>	.0356±.01194 <sup>a</sup>	.0016±.00156 <sup>b</sup>	.006

#### 3.1. Quail behavior

The results illustrated in Table 1 revealed that, quail chicks that were exposed to mobile phone radiation were less active in feeding, comfort and exploratory behavior, with more resting and standing, while non-significant differences in drinking, walking behavior than control groups

**Table 2:** Effect of phone radiation on Performance character:

parameters	Control	Control mobile (post hatching)	Mobile radiation (pre and post hatching)	P-Value
Initial body weight	5.0000 <sup>a</sup>	3.8000 <sup>b</sup>	3.6000 <sup>b</sup>	.057
Final body weight	216.3333 <sup>a</sup>	165.9000 <sup>b</sup>	141.0000 <sup>c</sup>	.000
Body weight gain	211.3333 <sup>a</sup>	162.1000 <sup>b</sup>	137.40002.11660 <sup>c</sup>	.000
Feed intake	590.0000 <sup>b</sup>	660.0000 <sup>a</sup>	678.33337.26483 <sup>a</sup>	.011
FCR	2.7926 <sup>c</sup>	4.0779 <sup>b</sup>	4.9377.02970 <sup>a</sup>	.000

#### 3.2. Quail performance

The results presented in Table 2 pointed that initial body weight, final body weight and body weight gain were declines while, feed intake and feed conversion ratio were increased in mobile phone group and control than control group.

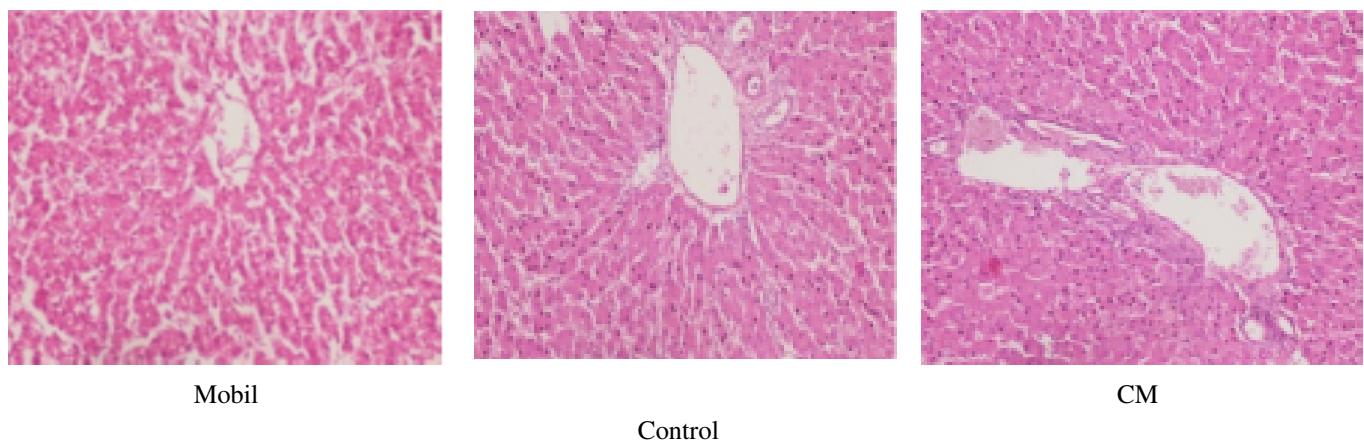
#### 3.3. Cortisol level (ng/ml):

Exposure to mobile phone radiation leading to an increase in cortisol level as showed in Figure. 2

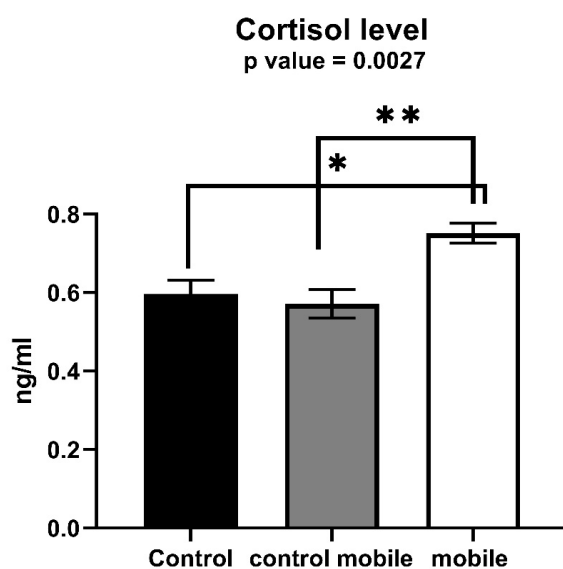
### 4. Discussion:

#### 4.1. Quail behavior

Quail chicks that exposed to mobile phone radiation less active in feeding, comfort and exploratory behavior than control group. These results were in agreement with [9, 10] and Pagadala et al., [11] summarized that decrease feeding behavior in rats exposed to RF-EMR, This data may be due to the histological changes in hepatic cell as showed in Figure. 1 cleared that liver showing sloughing of tunica intima inside the lumen of central vein (black arrow), disorganization and atrophy of hepatocyte, with vascular degeneration in quails exposed to mobile phone radiation compared to the control group. These findings are similar to those reported by Sultangaliyeva et al., [12] which revealed that the liver in the mobile group showed a slightly distorted architecture. on the other side, comfort behavior data agreement with [13] who found that, Rats exposed to RF-EMR exhibited half the number of grooming events compared to the control group, moreover, exploratory behavior data agreement with [14, 12] who found that exposed mice have shown a reduced exploratory behavior which may be due to that, stress-induced behavioral suppression. These alterations



**Figure 1:** histopathological changes in Liver of different groups of the experiment at the age of 35 day.



**Figure 2:** Effect of phone radiation on cortisol level:

in behavior may be associated with animal models of stress-related disorders.

this data may be due to that, the stressor activation of grooming is probably related to the adaptive need to reduce the level of arousal in animals under the action of EMR [12] While, the increasing in resting and standing behavior due to phone radiation these findings align closely with the data obtained from previous studies. [15] cleared that the animals exposed at 1 w/kg had a significantly increased number of non-active episodes (resting behavior) compared with the sham-exposed animals (control group). This data may be due to suppression of the emotional

sphere and the effect of radiation on kinetic center in brain. (Sultangaliyeva et al., 2020). Finally, The non-significant difference in walking activity between treated and control group. This data was agreed with finding of [16] found that general locomotion was not affected by the RF-EMR exposure.

#### 4.2. Quail performance

A significant decrease in feed intake and body weight in mobile phone group was agreed with previous finding of [11] who noted that daily food intake and body weight were decreased in rats exposed to RF-EMR compared to controls this data may be due to low frequency electromagnetic fields caused chick embryos to have abnormal eye malformation, as induced cataracts, corneal edema, endothelial cells loss and retinal degeneration were carried out in that leads to low feeding.[17], While, significant increase in FCR in mobile phone group was agreement with the results showed by [18] reported that FCR during 35 days of age was significantly better in the control group than those irradiated by doses of gamma before incubation.

#### 4.3. Cortisol level (ng/ml):

Increase in serum cortisol level was in agreement with Pawlak et al.,[19] and Pagadala et al.,[11] who noticed a significant increase in the serum corticosterone levels of



RF-EMR exposed rats compared to the control this data may be due to stress reaction of mobile radiation

## Conclusion

Mobile phone radiation has negative impact on quail behavior, performance and cortisol level which depend on the time for exposure as pre hatching only or pre and post hatching

## Authors, contribution

The authors contributed equally to the present investigation.

## Conflict of interest

The authors declare that there is no conflict of interest.

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