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Original Article

The effect of cell phone usage on semen quality and fertility among Jordanian males

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ABSTRACT

Background and objective: Cell phones emit radiofrequency electromagnetic radiation are prejudicial to human fertility. The objective was to study the effect of cell phone usage on semen quality and men's fertility.

Materials and methods: A cross-sectional observational study conducted on 159 men attending infertility clinics at North, Middle and South Governorates in Jordan and undergoing infertility evaluation were divided into two groups according to their active cell phone use: group A: $\leq$1 h/day and group B: >1 h/day. No interventions were given to patients and semen samples were collected by masturbation in a sterile container after an abstinence period of 5 days. The main outcome measures were sperm volume, liquefaction time, pH, viscosity, count, motility and morphology.

Results: There were no statistical significance differences ($p > 0.05$) between both groups regarding sperm quality parameters according to cell phone use, but there were statistical differences in the frequencies of sperm concentration, volume, viscosity, liquefaction time and means of immotile sperms and abnormal morphology. In addition, time spend on watching television and using wireless phones were significantly ($p \leq 0.05$) associated with decreasing mean percentages of normal morphology. The distance from telecommunication tower was significantly ($p \leq 0.05$) associated with decreasing sperms volume. Meanwhile, the time spend on sending or receiving messages was significantly ($p \leq 0.05$) associated with decreasing sperms count and carrying mobile phone in trouser pocket was significantly associated with increasing means of immotile sperms.

Conclusion: Cell phone use might have a negative effect on semen quality parameters and further research is needed.

1. Introduction

Cell phones are widely spread among all age groups especially adults and it has been noticed that people spend long hours using cell phones for different purposes. These phones emit radiofrequency electromagnetic waves (EMW), a low-level radiofrequency (RF), at a frequency of between 800 and 2200 MHz [1], that can be absorbed by the human body and have potential adverse effect on brain, heart, endocrine system, and DNA of humans and animals. They affect the brain electroencephalographic activity and cause disturbance in sleep [2]; difficulty in concentration, fatigue, and headache [3]; and increase reaction time in a time-dependent manner [4]. Additionally, they increase the resting blood pressure [5] and reduce the production of melatonin [6]. They are also implicated in DNA strand breaks [7], induce chromosomal instability and lead to increased cancer risk [4,7,8]. In addition, La Vignera [9] and his colleagues in 2012 suggested that mobile phones, and other electromagnetic devices that emit RF-EMR radiation, are prejudicial to human fertility.

Infertility defined as inability to conceive after a year of sexual intercourse without the use of contraceptives. It affects approximately 15% of couples of reproductive ages, and approximately 50% of these cases resulting from male factor infertility [8,10]. Men usually carry mobile phones in their pockets or in holders close to their reproductive organs. Thus, it is important to evaluate the effects of mobile phone use on male fertility. Although, many recent epidemiological studies have suggested that mobile phone use may play a role in male infertility [10–14], but the mode of action on the male reproductive system remains unclear. Mobile phones might influence the reproductive system via EMW thermal and non-thermal effects and they may interfere with normal spermatogenesis and result in a significant decrease in sperm quality [15–17]. However, the adverse impacts on semen quality that

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might cause due to cell phone usage have not been extensively addressed all over the world as well as in Jordan. Therefore, the objective of this study was to study the effect of cell phone usage on the semen quality and male fertility in Jordan.

2. Materials and methods

2.1. Study population and design

The study was approved by the Institutional Review Board committee at the three sites of data collection, and from each patient participating in the study an informed consent was obtained. The study design was a cross sectional observational study conducted on 159 men attending the infertility clinics in the North, Middle and South Governorates of Jordan between November 2015 and October 2016. The mean and the standard deviation (SD) age of the study participants was 33.26 (5.97) years. Participants had a history of smoking, alcohol consumption, orchitis, varicocele, diabetes mellitus, hypertension, cardiac, neural, or nephrotic disease, viral or bacterial infection in the past 4 weeks, or had a family history of genetic disease were excluded from the study.

2.2. Sample size determination

The sample size was determined depending on the prevalence of infertility worldwide which was estimated to affect 8–12% of reproductive aged couples [18]. The sample size was calculated using the infinite population equation $n = z^2pq/d^2$ [19]. Where n stands for sample size, z is the value of the 95% confidence level, P is the estimated average prevalence of infertility, q is $1 - p$ and d is the accepted error which is the precision around the population mean. Thus, the sample size required was: $n = (1.96)^2(0.1)(0.90)/(0.05)^2 = 138.3$. To guarantee the collection of the calculated sample size and to increase the power of the analysis, 20 more participants were collected.

2.3. Questionnaire

A structured, valid and reliable questionnaire was completed through a personal interview from each subject at the beginning of the study. All questions of the questionnaire were formed based on previous literature. To test whether the questionnaire is measuring what it intended to measure (validity), the questionnaire was reviewed by two specialists in obstetrics and gynecology. For testing whether the questionnaire consistently measures whatever it supposed to measure (reliability or repeatability) a pilot study was carried out on 10–15 non-participants' men before applying the questionnaire on the study population and was tested after completion using reliability coefficient (alpha) test and was revised accordingly. Also, to ensure the reliability, the questionnaire was completed for a second time after the completion of semen analysis in the participant next visit and Kappa coefficient statistic test was used to measure the agreement of answers of each question. Answers with Kappa coefficient <0.7 was excluded from the analysis. To ensure consistency, the questionnaire was completed only by the main researcher through personal interview with participants using a constant standardized procedure.

2.4. Semen collection and patients grouping

A sterile wide-opening calibrated container was utilized to collect the semen samples after an abstinence period of 5 days by masturbation. Moreover, the World Health Organization (WHO) guidelines were used to evaluate sperm parameters including volume, liquefaction time, pH, viscosity, sperm concentration, motility and morphology [20]. All semen samples were analyzed by the same research certified laboratory technician who was blinded to the study participants cell phone usage. Time of talking by cell phone was recorded and the subjects were divided into 2 groups; group $A \leq 1$ h/day (n = 104); group B > 1 h/day (n = 52) and participants who did not use cell phone (n = 3) were excluded from the statistical analysis regarding studying the effect of time spent in calling or receiving calls.

2.5. Statistical analysis

Collected data was entered twice in data sheets, checked and analyzed using SPSS statistical package (IBM, SPSS version 22, 2013). Descriptive statistics were performed using frequency as well as means and standard error of the means (SEM) to describe the categorical and numeric data, respectively. The nonparametric Kolmogorov-Smirnov test was used to examine all numeric variables for normal distribution. Student *t*-test for independent variables was used to compare means of the normally distributed numeric variables. Numeric variables were converted to categorical variables according to international and/or the laboratory cutoff points. The Pearson's Chi-square (χ^2) and Fisher's exact tests were applied to assess the associations among dichotomous and categorical variables and P-value $\leq$0.05 was considered significant.

3. Results

The study participants were (n = 159), their mean age was 33.26 ± 0.47 years, 98.1% using cell phone, and 32.7% of them calling or receiving calls per day for more than one hour. The frequency distributions of the socio-demographic and lifestyle characteristics of the study participants showed that, 69.2% had children, 44.6% living in villages, 90.6% using television remote controls, 72.3% were not using computers, 34.6% were using wireless (cordless) phones, 63.5% were carrying their mobiles in the pocket of the trouser, 77.4% sending messages by mobile, 38.4% using blue tooth technique, 37.1% working or living near telecommunications tower and 78.6% did not reported a family history of infertility. The descriptive statistics of the study participants regarding anthropometry and lifestyle characteristics are shown in Table 1. The mean values and frequencies of the study participants semen quality are presented in Table 2 which showed higher means of immotile sperms (55.00 ± 2.05) comparing to straight forward motile sperms (2.39 ± 0.45), a lower means of normal oval morphology (7.15 ± 0.75) comparing to abnormal morphology (66.0 ± 2.35) and the semen concentration mean was (31.04 ± 2.90) million/ml. In addition, 75.5% had abnormal viscosity and 95% their liquefaction time completed within 20 min.

Table 3 showed that there was no statistically significant difference (P > 0.05) between the study participant groups regarding time spend in calling or receiving calls by cell phones and the semen quality parameters. Nevertheless, there were statistical differences regarding sperm count >20 million/ml (63.2% vs 36.8%), volume >3 ml (62.7% vs 37.3%), normal viscosity (71.8% vs 28.2%), complete liquefaction within 20 min (66.9% vs 33.1%), mean of the percent immotile sperms (52.64 ± 2.58 vs 59.87 ± 3.48) and the mean of the percent abnormal sperm morphology (63.07 ± 2.95 vs 70.32 ± 4.01) respectively.

Furthermore, there were a few statically significant associations ($P \leq 0.05$) between some of the semen quality parameters and some of the study variables (Table 4). The mean percentage of the morphology normal was significantly (P = 0.024) higher for the participants watching television $\leq$3 h/day compared with participants watching television >3 h/day. The mean percentage of morphology abnormal was significantly (P = 0.047) higher for the