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ORIGINAL ARTICLE

What is harmful for male fertility: Cell phone or the wireless internet?

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Abstract In this study, we aimed to assess the potential harmful effects of radiofrequency-electromagnetic radiation on sperm parameters. We requested semen for analyses from the male patients coming to our infertility division and also asked them to fill out an anonymous questionnaire. We queried their mobile phone and wireless internet usage frequencies in order to determine their radiofrequency-electromagnetic radiation exposure. A total of 1082 patients filled the questionnaire but 51 of them were excluded from the study because of azoospermia. There was no significant difference between sperm counts and sperm morphology excluding sperm motility, due to mobile phone usage period, ($p = 0.074$, $p = 0.909$, and $p = 0.05$, respectively). The total motile sperm count and the progressive motile sperm count decreased due to the increase of internet usage ($p = 0.032$ and $p = 0.033$, respectively). In line with the total motile sperm count, progressive motile sperm count also decreased with wireless internet usage compared with the wired internet connection usage ($p = 0.009$ and $p = 0.018$, respectively). There was a negative correlation between wireless internet usage duration and the total sperm count ($r = -0.089$, $p = 0.039$). We have also explored the negative effect of wireless internet use on sperm motility according to our preliminary results.

Conflicts of interest: All authors declare no conflicts of interest.

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Introduction

Cell phone and wireless internet have become an indispensable part of our lives. Especially, after the development of smart phones and 3G internet technologies, the exposure to the radiofrequency (RF) electromagnetic radiation (EMR) has increased to terrifying levels. Cell phone and wireless technologies (Wi-Fi) operate from 850 MHz to 1800 MHz and ~2400 MHz; respectively [1,2]. Tissues can absorb RF-EMR in many ways including aerial effect and/or coupling the signal [3]. Previously, the harmful effects of RF-EMR on DNA integrity and on various organs such as the brain and heart have been very well described [4]. The World Health Organization (WHO) officially declared that cell phones can cause brain cancer [5]. After this declaration, usage of hands-free devices has increased but cell phones still remain close to the gonads of individuals that may result in infertility due to the harmful effects of RF-EMR.

Infertility is a common disorder that affects 15% of couples and nearly half of the cases are due to male infertility. As mentioned above, RF-EMR affects many organs including the testes by a direct or a thermal effect [6]. In one study, detrimental effects of RF-EMR on Leydig cells, seminiferous tubules, and especially the spermatozoa were clearly defined [1]. Although RF-EMR reduces testosterone levels, impairs spermatogenesis, and causes sperm DNA damage [4], the relationship between RF-EMR devices and male infertility is still controversial.

In the literature, the harmful effects of RF-EMR on male reproductive systems are shown in rats, however; human studies are very rare and can only be planned with a smaller population [4,7]. For instance, Agarwal et al [4] detected the negative effects of cell phones on sperm parameters in 361 men. Similarly, Fejes at al [7] showed the negative correlation between the daily cell phone usage duration and semen quality in 371 men. In this decade, wireless internet connection has been involved in our lives as much as cell phones with 3G technologies. As we all know, Wi-Fi connection transmits more RF-EMR than cell phones, so we examined the effects of both cell phone and wireless internet use on sperm parameters in healthy males in order to determine the possible harmful effects of RF-EMR devices.

Materials and methods

This study was performed under the approval of our Institutional Review Board in our university (Turgut Ozal University, Ankara, Turkey) (999500669/869), and informed consents were obtained from all patients. In our population based observational study, we collected data from 1082 healthy men who attended the Andrology subdivision of the Urology Department (Turgut Ozal University) between June 2013 and June 2014. Men with a history of orchitis, varicocele, diabetes mellitus, cardiac, neural disease, nephritic disease, and hypertension, or men who had a family history of any genetic disease were excluded from the study. In addition, patients who suffered from a viral/bacterial infection in the previous 4 weeks, had an *in vitro* fertilization history, or were already recruited to an intacytoplasmic sperm injection program were also excluded from the study. Azoospermic patients were excluded from the study. Semen samples were collected by masturbation in a sterile wide-mouthed calibrated container (Sigma, St. Louis, MO, USA) with the abstinence of ejaculation for a minimum of 2 days and no longer than 5 days before the semen collection. Semen analyses were performed according to the WHO guidelines that include eight sperm parameters: volume, liquefaction time, pH, viscosity, sperm count, motility, viability, and percentage of the normal morphology [8]. Assessments of semen analysis were performed at the end of the 30-minute period. Sperm motility was analyzed by using a phase-contrast microscope (Nikon, Alphaphot-2, YS-2, Tokyo, Japan) with $> 20\times$ magnification. Semen analyses were performed by two experienced and blinded operators. Motility and concentrations of semen were evaluated by using a Makler counting chamber (Sefi-Medical Instrument, Haifa, Israel). WHO criteria (4 categories of sperm movement; A: rapid progressive, B: slow progressive, C: nonprogressive, and D: no motility) were used in the assessment of sperm movement. Azoospermic patients and the patients whose sperm counts were < 5 million/mL were excluded from the study due to possible factors such as genetic, testicular hypofunction, or idiopathic. An anonymous questionnaire including (1) daily the cell phone usage duration, (2) habits of carrying mobile phone, (3) wireless internet usage duration, and (4) type of internet usage. According to an anonymous questionnaire, daily active cell phone usage was divided into three groups as following: Group A, < 30 min/d; Group B, from 30 min/d to 2 h/d; and Group C, > 2 h/d. Habits of carrying a mobile phone was recorded as (A) in the pocket of trousers, (B) in a handbag, or (C) in the pocket of jackets. Wireless internet usage was divided in to three groups, Group A: < 30 min/d; Group B, from 30 min/d to 2 h/d; and Group C, > 2 h/d. Internet usage types recorded as wireless or not. Body mass index and annual smoking habits (at least 10 cigarettes a day) were also recorded. Because of the high number of participants we could not ask about the cell phone models but we know that all of the cell phones operate between the 850—1800 Mhz in our country.

Correlation between the eight sperm parameters was evaluated by the determination of the Pearson correlation coefficients. Data were presented as mean $\pm$ standard deviation. Statistical analyses were performed by using Student t test (2-tailed) and one way analysis of variance (ANOVA). SPSS for Windows (version 16.0; SPSS Inc., Chicago, IL, USA) was used for statistical analyses and $p < 0.05$ was considered as statistically significant.

Results

Fifty-one azoospermic patients were excluded from the study, and the data of 1031 patients were collected. The average age of the participants was 30.9 $\pm$ 6.2 (18—63) years. The average body mass index of participants was 26.8 $\pm$ 3.9 (14.9—46.24). Smoking rate was 352/1031 participants. Of those men, the average smoking duration was 9.94 $\pm$ 5.64 (2—35) years.