Ann Agric Environ Med 2007, 14, 169-172

EVALUATION OF THE EFFECT OF USING MOBILE PHONES ON MALE FERTILITY

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Wdowiak A, Wdowiak L, Wiktor H: Evaluation of the effect of using mobile phones on male fertility. *Ann Agric Environ Med* 2007, **14**, 169-172.

Abstract: The problem of the lack of offspring is a phenomenon concerning approximately 15% of married couples in Poland. Infertility is defined as inability to conceive after a year of sexual intercourses without the use of contraceptives. In half of the cases the causative factor is the male. Males are exposed to the effect of various environmental factors, which may decrease their reproductive capabilities. A decrease in male fertility is a phenomenon which occurs within years, which may suggest that one of the reasons for the decrease in semen parameters is the effect of the development of techniques in the surrounding environment. A hazardous effect on male fertility may be manifested by a decrease in the amount of sperm cells, disorders in their mobility, as well as structure. The causative agents may be chemical substances, ionizing radiation, stress, as well as electromagnetic waves. The objective of the study was the determination of the effect of the usage of cellular phones on the fertility of males subjected to marital infertility therapy. The following groups were selected from among 304 males covered by the study: Group A: 99 patients who did not use mobile phones, Group B: 157 males who have used GSM equipment sporadically for the period of 1-2 years, and Group C: 48 people who have been regularly using mobile phone for more than 2 years. In the analysis of the effect of GSM equipment on the semen it was noted that an increase in the percentage of sperm cells of abnormal morphology is associated with the duration of exposure to the waves emitted by the GSM phone. It was also confirmed that a decrease in the percentage of sperm cells in vital progressing motility in the semen is correlated with the frequency of using mobile phones.

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Key words: mobile phones, male fertility.

INTRODUCTION

The problem of the lack of offspring is a phenomenon concerning approximately 15% of married couples in Poland. Infertility is defined as inability to conceive after a year of sexual intercourse without the use of contraceptives. In half of the cases the causative factor is the male. Males are exposed to the effect of various environmental factors which may decrease their reproductive capabilities [3, 13]. A decrease in male fertility is a phenomenon which occurs over the years [2, 8, 14]. This may suggest that one of the reasons for the decrease in semen parameters is the effect of the development of techniques in the surrounding environment. A hazardous effect on male fertility may be manifested by a decrease in the amount of sperm cells, disorders in their motility, as well as structure. The causative agents may be chemical substances, ionizing radiation, stress, as well as electromagnetic waves [3, 12, 13].

Recent years have seen a very rapid development in cellular telecommunications based on the emission of electromagnetic waves, the effect of which on human health has not yet been fully confirmed.

The effect of electromagnetic waves on living organisms depends on the wave frequency and intensity. The hazardous effect of radio waves of high frequency (0.3-300 GHz) is associated with an increase in body temperature [2]. The waves emitted by mobile phones are of an at least 10-fold lower frequency (0.1-30 MHz). These waves may exert an

Received: 5 March 2007
Accepted: 29 May 2007

effect on the state of polarisation of the cellular membranes in the human body. An adequate polarisation of cellular membranes is responsible for the process of spermatogenesis, and for the properties of a sperm cell enabling its penetration into the egg cell.

Due to a large amount of potentially hazardous factors, it is difficult to isolate one individually in order to examine its effect on the male sperm.

Today, studies of the effect of mobile telephones on the human body are especially justified, and may allow the development of possible prophylactic activities leading to the limitation of potentially hazardous influence of cellular phones on the human body.

OBJECTIVE

The objective of the study was determination of the effect of the usage of cellular phones on the fertility of males undergoing marital infertility therapy.

MATERIAL AND METHODS

The studies were conducted during the period June 2004 – May 2006 among patients treated in two outpatient departments in Lublin due to marital infertility. The research method was a questionnaire form, while the technique – a diagnostic survey. Simultaneously, respondents' sperm was subject to examination according to the WHO standards [16], adopting the following standard parameters of ejaculation:

Volume	– 2.0 ml or more;
Concentration	– 20 mln sperm cells/ml or more;
Mobility	– 50% or over progressive, (i.e. type A and B) and more type A;
Type A	– rapid, rectilinear, progressive motility;
Type B	– slow, poorly linear, non-linear motility;
Morphology	– 30% or more, with normal morphology.

Sexual abstinence prior to the sampling of semen was 2-7 days. Sperm was obtained by the method of masturbation in a selected room near the laboratory. Males with the symptoms of systemic diseases were excluded from the study group, as well as patients with clinically confirmed features of an inflammatory state of the reproductive organ. In addition, from the study group were eliminated males with body mass disturbances, the exponent of which was a BMI index below 17 or over 30, as well as patients with hormonal, pre- and post-natal development disorders in the region of male reproductive organs. Patients with the presence of clinically examinable varices of the spermatic cord, which may affect the quality and concentration of the sperm within the period of 3 months prior to the survey, were not qualified for the study.

The survey consisted of questions concerning the place of residence (division: rural area, town with a population of up 50,000; a large city with a population of over 50,000), age, loading with smoking habit (division into groups: Group A – non-smokers, Group B – regular smokers up to 20 cigarettes daily, and C – those smoking more than 20 cigarettes a day), occupation performed, and usage of mobile phone. The results obtained were subjected to statistical analysis by means of chi-square test for independence, adopting the level of significance of 0.05. The statistical package SPSS for Windows was used. The results were analysed from the aspect of relationship between the usage of the phone and semen parameters.

RESULTS AND DISCUSSION

The following groups were selected from among 304 males covered by the study: Group A: 99 patients who did not use mobile telephones, Group B: 157 males who have used GSM equipment sporadically for the period of 1-2 years, and Group C: 48 people who have been regularly using mobile phones for more than 2 years.

Groups A, B and C were compared from the aspect of load of cigarette smoking habit. No significant differences were observed in the frequency of occurrence of cigarette smoking habit (χ^2=1.46, p>0.05). The statistical analysis also did not show any significant differences between the control group and the study group with respect to the following parameters: respondents' age (χ^2=1.48, p>0.05), place of residence (χ^2=1.38, p>0.05), and the occupation performed (χ^2=1.46, p>0.05).

The results concerning the concentration of semen obtained from spermiograms were divided into the 5 following groups:

1 – patients with azoospermy (lack of sperm cells in the ejaculate);
2 – up to 3 mln/ml (severe oligozoospermy);
3 – from 3-10 mln/ml (moderate oligozoospermy);
4 – from 10-20 mln/ml (light oligozoospermy);
5 – concentration of over 20 mln/ml satisfying the WHO standards.

Considering the percentage of sperm cells in type A live progressive motility of sperm cells, the results of the sperm test obtained were divided into 4 groups:

1 – over 50% motility A + B in semen;
2 – from 20-40% motility A + B in semen;
3 – from 5-19% of motility A+B in semen;
4 – below 5% of motility A+B in semen.

Based on the percentage of sperm cells of abnormal structure, the division was made into the following groups:

1 – over 30% normal sperm cells;
2 – from 20-30% of normal cells;
3 – from 10-19% of normal cells;
4 – from 3-9% normal sperm cells;
5 – below 3% of normal sperm cells.

While evaluating the effect of the frequency of using GSM phones on the vitality of sperm cells it was observed that 65.7% of males not using this equipment have a normal spermiogram with respect to the parameters concerning the percentage of sperm cells in live vital and slow progres-

Table 1. Relationship between frequency of using mobile phones and mobility of sperm cells in semen; χ^2=23.2, p<0.001.

	over 50% motility A + B in semen		from 20-40% motility A+B in semen		from 5-19% motility A+B in semen		below 5% motility A+B in semen		Total	
	N	%	N	%	N	%	N	%	N	%
Patients without mobile phones (A)	65	65.7	9	9.1	14	14.1	11	11.1	99	100
Sporadically using mobile phones	81	51.6	27	17.2	30	19.1	19	12.1	157	100
Frequently using mobile phones	17	35.4	17	35.4	12	25.0	2	4.2	48	100
Total	163	53.6	53	17.4	56	18.4	32	10.5	304	100

Table 2. Relationship between frequency of using mobile phones and pathology of sperm cells structure; χ^2=36.859, p<0.001.

	over 30% normal sperm cells		from 20-30% normal sperm cells		from 10-19% normal sperm cells		from 3-9% normal sperm cells		below 3% normal sperm cells		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Patients without mobil phones	55	55.6	23	23.2	7	7.1	1	1.0	13	13.1	99	100
Sporadically using mobile phones	46	27.4	55	35.0	24	15.3	11	7.0	24	15.3	157	100
Frequently using mobile phones	8	16.7	19	39.6	4	8.3	6	12.5	11	22.9	48	100
Total	106	34.9	97	31.6	35	11.5	18	5.9	48	15.8	304	100

sive motility. It was noted that 35.4% of people frequently using the phones have results within the standard, while 51.6% of the remaining respondents are classified into the group with normal vitality of semen. Slight disturbances in the mobility of sperm cells (20-40% motility A) occurred in Group A in 9.1% of respondents, in Group B – in 17.2%, whereas in Group C – these disturbances concerned 35.4% of patients (Tab. 1).

While investigating the relationships between the pathology of the semen and usage of GSM phones it was confirmed that 55.6% of males not possessing phones have semen with the normal percentage of sperm cells with proper morphology, 23.2% of these patients have slightly elevated pathology of the semen, 7.1% have 10-19% normal structure cells, while 13.1% show a profound pathology of the semen. In the group of people who sporadically used phones, 27.4% of respondents did not show deviations from the standard with respect to the pathology of spermiograms, 35% had a slightly elevated amount of abnormal sperm cells, 15.3% of these males possessed from 10-19% of normal sperm cells, while in 15.3% the pathology reached approximately 100%. In the group of people often using mobile phones, 16.7% possessed normal morphology of semen, 39.6% slightly decreased morphology, 8.3% had from 10-19% of normal sperm cells, whereas total teratozoospermy occurred in 22.9% of respondents from this group (Tab. 2).

While analysing the frequency of using mobile phones on the concentration of the sperm, no statistically significant differences were noted (χ^2=1.48, p>0.05).

DISCUSSION

The evaluation of the effect of mobile telecommunications on the state of human health is a difficult issue, which results from the fact that there is a problem with isolating from various environmental factors the particular one that may be caused by electromagnetic waves emitted by mobile phones. In addition, waves of the same frequency may be emitted by various other appliances. The effect of waves emitted by phones in association with other factors should also be considered. It may be presumed that people who intensively use phones more often perform sedentary work. This is conducive for the elevation of temperature in the region of the scrotum, and infertility. People who talk on the phone, to a greater degree may be exposed to stress, which by affecting the level of cortisol, prolactine and testosterone may contribute to the decrease in the concentration of the semen [13].

Males who are very active occupationally, apart from exposure to stress, to a greater degree could come into contact with chemical environmental agents as a result of inadequate nutrition (e.g. pesticides, the effect of which on male fertility has not been proved), frequent contact with motorization (hazardous effect of contact with heavy metals), or an individual contact with chemical substances in association with performance of an individual occupation [13].

While investigating the effect of mobile phones on the parameters of semen, Erogul obtained results similar to those in the presented study [6]. Analogous conclusions

were also simultaneously drawn by Fejes [7] and Aitken [1] in their studies concerning the mobility of sperm cells and the use of GSM. Łopucki *et al.* [10] also obtained results similar to the presented study.

Studies of the effect of electromagnetic waves on the human body are also hindered in association with the ethical aspects of these activities. In the case of studies conducted on animals, the problem is of lesser importance, and additionally, it is easier to isolate the effect of a hazardous factor from among potentially hazardous factors. The results of the studies conducted on animals, however, cannot be directly referred to the human body.

In the studies by Dasdag carried out on rats, the effect of waves emitted by GSM phones on the semen of these animals was not observed [4]. In the studies conducted on chicken embryos, Grigorev [9] confirmed an increase in mortality in the study group subjected to the effect of electromagnetic field as emitted by mobile phones, compared to the control group. Wierzchoś [15] arrived at similar conclusions while studying rabbit embryos. Nakamura, while investigating the influence of electromagnetic waves on pregnancy in rats, also confirmed their harmful effect [11]. It should be taken into consideration, however, that the studies conducted on animals cannot be unequivocally transferred to humans, which is also confirmed by Derias [5].

While analysing the scientific reports pertaining to electromagnetic waves, it may be suspected that the use of mobile phones can decrease male fertility, and the presented results of studies require continuation within a longer time span and on a larger group of males.

CONCLUSION

1. A decrease in the percentage of live sperm cells in a vital, progressive motility in semen is correlated with the frequency of usage of mobile phones.

2. An increase in the percentage of sperm cells with abnormal morphology is associated with the duration of exposure to the waves emitted by GSM equipment.

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