

# **MENSTRUAL CHANGES AND PREGNANCY OUTCOMES AMONG PHYSIOTHERAPISTS EXPOSED TO NON-IONIZING RADIATIONS**

By

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## **Abstract**

**Introduction:** Excessive exposure to radiofrequency (RF), electromagnetic fields (EMFs) from the diathermy devices could result in adverse pregnancy / reproductive outcomes. Aim of Work: to assess the menstrual changes, hormonal profile and pregnancy outcomes among female physiotherapists exposed to non-ionizing radiations. **Materials and Methods:** a prospective study, included 120 female workers at the physiotherapy departments with 160 healthy controls (non-exposed), who were allocated into two groups: pregnant (50 physiotherapists and 75 controls) and non-pregnant (70 physiotherapists and 85 controls). Outcome measures in the pregnant group included pregnancy outcome while in non-pregnant group were menstrual irregularities, abnormal uterine bleeding and abnormal hormonal profile. **Results:** There was a highly significant difference between the exposed pregnant and controls regarding low birth weight ( $p < 0.001$ ). There was no significant difference between the non pregnant exposed and controls regarding menstrual irregularities, and hormonal assay ( $p > 0.05$ ). **Conclusion:** female physiotherapists have no increased risks for menstrual irregularities, abnormal hormonal profile or adverse pregnancy outcome except for low birth weight which needs future research.

**Key words:** Female physiotherapists, Adverse pregnancy outcome, Menstrual irregularities and Hormonal assay.

## Introduction

Excessive exposure to radiofrequency (RF), electromagnetic fields (EMFs) from the diathermy devices could result in adverse pregnancy / reproductive outcomes (Shaw, 2001, Feychtin, 2005 and Mjoen et al., 2006).

Adverse pregnancy outcomes among physiotherapists have been the focus of research over the past two decades. Reported associations between physiotherapists' occupational exposure to non-ionizing radiations (NIR) from diathermy use and the occurrence of spontaneous abortions, still births, congenital fetal malformations and low birth weights have been identified (Kurppa et al., 1983, Logue et al., 1985 and McDonald et al., 1987).

A recent systematic literature review of adverse reproductive outcomes associated with physiotherapists' occupational exposures to non-ionizing radiations revealed inconsistent evidence and recommended further prospective research trials (Shah and Farrow, 2014).

## Aim of Work

The aim of this study was to assess the menstrual changes, hormonal profile and pregnancy outcomes among female physiotherapists exposed to non-ionizing radiations.

## Materials and Methods

- **Study design:** This was a prospective study
- **Place and duration of study:** carried out at the Department of Public Health and Community Medicine, Faculty of Medicine, Menoufia University, Menoufia, Egypt, in the period between November 2013 and November 2015.
- **Study sample:** Included female physiotherapists were recruited from Physiotherapy departments at Menoufia University Hospital and Shibin Elkom Teaching Hospital.

Based on the rate of menstrual irregularities and adverse pregnancy outcome in the general population from the literature; accordingly, at alpha = 0.05 and a study power of 80% a total

sample size of 90 participants was required after adding a percentage of 10% for possible drop out cases during the study. We enrolled 120 female workers at the physiotherapy departments after exclusion of non-responders with 160 healthy controls (non-exposed) matched for age and body mass index (BMI). Controls were recruited from the outpatient clinics with no history of work at anyplace which could expose them to non-ionizing radiation. All the recruited women were in the childbearing period with postmenopausal women excluded from the study.

Enrolled women were divided into two groups with their respective controls

**Group 1 (pregnant):** included 50 pregnant physiotherapists and 75 pregnant controls.

**Group 2 (non-pregnant):** included 70 non-pregnant physiotherapists and 85 non-pregnant controls.

#### **- Study methods**

**I - Women in the pregnant group** were subjected to a self designed

questionnaire including age, parity, period of gestation and occupational exposure (duration of employment, nature of their job, mean hours of the daily work, number of days worked/week, any health disorders encountered & their management) were noted.

- Clinical examination was also recorded.
- Ultrasonography was done to confirm gestational age, congenital malformation, and estimated fetal weight. Follow-up antenatal visits were done till the end of the puerperium. Women with medical disorders affecting pregnancy outcome as diabetes mellitus, hypertension, bronchial asthma or epilepsy were excluded from the study.

**Outcome measures were:** rate of abortion, congenital fetal anomalies, preterm deliveries and neonatal outcome in terms of neonatal weight, admission to neonatal intensive care unit and perinatal mortality rate.

**II-Women in the non-pregnant group** were subjected to a self designed

questionnaire including detailed history of occupational exposure.

- Clinical examination was done
- Hormonal assay in the third day of the menstrual cycle to measure serum follicle stimulating hormone (FSH), leutinizing hormone (LH) and prolactin. Radioimmunoassays were used to determine serum levels of LH (Autodelfia; Wallac Oy, Turku, Finland), FSH (Enzymun ES700; Böhringer Mannheim, Mannheim, Germany), and prolactin (Immunotech, Westbrook, ME, USA) at clinical pathology department. Normal values of hormonal levels were FSH = 3–13 mIU, LH = 1.5–12 mIU/ml and Prolactin = 2–22 ng/ml. Women with chronic disease or endocrinal disorder affecting the ovarian function were excluded from the study.

**Outcome measures** were number of participants with menstrual irregularities in terms of polymenorrhea (frequency of menstruation less than 21 days), oligomenorrhea (frequency

of menstruation more than 35 days), menorrhagia (excessive menstruation more than 7 days) and abnormal uterine bleeding (intermenstrual bleeding or contact bleeding), and abnormal hormonal profile.

### **Consent:**

The study protocol and its benefits and complications were explained to all participants, and all recruited subjects completed and signed the informed consent' form. The consent form developed according to the international ethical guidelines for biomedical research involving human subject, as prepared by the Council for International Organizations of Medical Sciences in collaboration with the World Health Organizations.

### **Ethical approval:**

The respective approvals of the review board and the ethics committee of the Menoufia Faculty of Medicine were obtained before commencing the study.

### **Statistical analysis:**

Crude relationships between

pregnancy outcome and exposure to shortwaves and radiofrequency were estimated by the odds ratio (O.R.) together with the exact 95% confidence interval (95% CI). Chi-squared test ( $\chi^2$ ) was used for categorical variables. Fisher exact test was used for

categorical variables when the expected value was less than 5. Student's t-test for continuous quantitative parametric variables was used. Comparisons of data were made with overall  $\alpha$  error set at 0.05 (2-tailed). Analyses were conducted with SPSS v. 20 software (SPSS Inc, Chicago, Ill).

## Results

**Table (1) Participants' characteristics**

	Group 1 (Pregnant)		Student t-test	P-value	Group 2 (non-pregnant)		Student t-test	P-value
	Exposed (n=50)	Control (n=75)			Exposed (n=70)	Control (n=85)		
<b>Age in years</b>	30.3±3.2	31.2±2.1	1.90	>0.05	23.5±3.9	24.2±4.2	1.07	>0.05
<b>BMI</b>	23.4±3.5	24.3±5.1	1.09	>0.05	23.6±4.6	24.8±3.9	1.76	>0.05
<b>Parity</b>	2.6±0.6	2.5±0.7	0.83	>0.05	1.3±0.3	1.4±0.4	1.73	>0.05

BMI=Body mass index

Table (1) reveals the participants' characteristics. There were no significant difference between the exposed and control groups regarding age, parity and BMI ( $p>0.05$ ).

**Table (2) Occupational exposure of physiotherapists (n=120).**

Variable	Physiotherapists (n=120)
<b>-Duration of employment in years (mean±SD)</b>	8.5±3.8
<b>-Nature of job (n/%)</b>	
Radiofrequency.	52(43.3%)
Short wave diathermy.	37(30.8%)
Microwave diathermy.	31 (25.9%)
<b>-Duration of exposure to short wave and radiofrequency/weak (mean±SD)</b>	16.8±4.3
<b>-Distance from the devices in meters (mean±SD)</b>	2.6±1.1

Table (2) reveals the occupational exposure data of the exposed subjects which included duration of employment in years, nature of job, duration of exposure to short wave and radiofrequency/weak and the distance from the devices in meter.

**Table (3) Pregnancy outcome in pregnant physiotherapists in comparison to control group.**

	Exposed (n=50) (n/%)	Control (n=75) (n/%)	Chi-square	O.R. (95% CI)	P-value
<b>Abortion</b>	7(14.0%)	8(10.7%)	0.08	1.36 (0.46-4.03)	>0.05
<b>Congenital fetal malformations</b>	2(4.0%)	0(0%)	3.05*	----	>0.05
<b>Preterm labour</b>	2(4.0%)	1(1.3%)	0.56*	3.08 (0.27-34.95)	>0.05
<b>Neonatal outcome</b>					
<b>-Low birth weight</b>	9(18%)	2(2.6%)	8.79	8.01 (1.65-38.37)	<0.01*
<b>-Admission to NICU</b>	3(6%)	2(2.6%)	0.39*	2.33 (0.38-14.47)	>0.05
<b>-Perinatal mortality</b>	2(4%)	1(1.3%)	0.56*	3.08 (0.27-34.95)	>0.05

\*: Statistically significant

Table (3) shows pregnancy outcome in pregnant physiotherapists in comparison to control group. There was a highly significant difference between the exposed and controls regarding low birth weight ( $p < 0.001$ ). No difference between the two groups regarding the rate of abortion, congenital fetal malformations, preterm labour and perinatal mortality ( $p > 0.05$ ).

**Table (4) Menstrual changes and hormonal assay in non-pregnant physiotherapists in comparison to control group.**

	Exposed (n=70)	Control (n=85)	Chi-square	P-value
<b>Menstrual irregularity:</b>				
-Polymenorrhea.	5 (7.1%)	8 (9.4%)	0.26	>0.05
-Oligomenorrhea.	3 (4.3%)	4 (4.7%)	0.02	>0.05
-Menorrhagia.	1 (1.4%)	3 (3.5%)	0.63 <sup>#</sup>	>0.05
<b>Abnormal uterine bleeding:</b>				
-Intermenstrual bleeding	3(4.3%)	2(2.4%)	0.67 <sup>#</sup>	>0.05
-Contact bleeding	2 (2.9%)	1(1.2%)	0.59 <sup>#</sup>	>0.05
<b>Hormonal profile:</b>				
-FSH.	5.4±0.2	5.6±0.9	1.88*	>0.05
-LH.	6.5±1.7	6.1±1.1	1.79*	>0.05
-Prolactin	7.8±2.3	8.2±2.1	1.15*	>0.05

#Fisher's Exact test, \*Student's t test

Table (4) shows menstrual changes and hormonal assay in non-pregnant physiotherapists in comparison to control group. There was no significant difference between the two groups regarding menstrual irregularities, abnormal uterine bleeding and hormonal assay ( $p > 0.05$ ).

## Discussion

In this study, physiotherapists have been in this occupation over 8 years (mean±SD of 8.5±3.8) with more than 16 hours exposure per week (mean±SD of 16.8±4.3) and at a distance more than one 1.4 meters from the working devices (mean±SD of 2.6±1.1).

The minimum safe distance for physiotherapists according to the latest Occupational Exposure Limits (OELs) recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), 2009 is one meter. However, a recent literature review recommended revision of this distance to be at least 2 meters for continuous short wave diathermy (CSWD) and 1.5 meters for pulsed short wave diathermy (PSWD) (Shah and Farrow, 2013).

In this series, there was no significant difference between pregnant physiotherapists and the controls regarding pregnancy outcome in terms of abortion (5.7% versus 2.85%), congenital fetal malformations (1% versus 0%), preterm labour (2.8% versus 2.8%) and neonatal outcome (admission to NICU & perinatal mortality) which appears to be

consistent with the general population. None of the pregnant women consume alcohol, coffee or tobacco to alleviate their effects on pregnancy (Armstrong et al., 1992). The rate of low birth weight was significantly higher among pregnant physiotherapists which have to be clarified in future studies.

The incidence of major fetal abnormalities apparent at birth is 2 to 3% in the general population (Lee et al., 2001) while the incidence of preterm labour varies between 7-12% according to the studied population (Ananth et al., 2005 and Ananth et al., 2009).

In a previous review of pregnancy outcome among female workers exposed to electromagnetic fields (EMF) concluded that most studies of EMF exposures have not demonstrated any consistent risk increases for adverse pregnancy outcomes, but limitations in the exposure assessment methods and very limited power to study high exposure levels prevents any conclusions. Findings of an increased risk of spontaneous abortion in relation to maximum magnetic field exposures in two studies need to be confirmed. Studies of RF exposure have mostly

been limited to physiotherapists and although some positive findings have been reported, no specific type of malformation or other adverse outcome has been consistently reported (Feychting, 2005).

In this study, there was no significant difference between non-pregnant physiotherapists and the controls regarding menstrual changes and hormonal profile which is consistent with the general population and reported for the first time in literature.

In comparison to previous studies, this study is the first case-control prospective study with high response rate and in which, the period of occupational exposure and distance from the working devices were trickled.

Future research should explore the effect of occupational exposure during pregnancy on the neonatal birth weight on larger number of physiotherapists.

### **Conclusion**

Female physiotherapists have no increased risks for menstrual irregularities, abnormal hormonal profile or adverse pregnancy outcome except for low birth weight which needs future research.

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### **Conflicts of interest**

I certify that no actual or potential conflicts of interest in relation to this article exist.

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