

Original Article

The Effect of Occupational Risk Factors on Pregnancy and Newborn Infants of Pregnant Midwives and Nurses in Turkey: A Prospective Study

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Abstract

Background: Nurses and midwives work in dangerous and very dangerous workplace and are exposed to various occupational risks. The risks of exposure during pregnancy is for themselves and threaten also the fetus' health.

Aim: To determine occupational risks encountered by, nurses during pregnancy, and to evaluate the impact of these risks on pregnancy and the health of newborn infants.

Methods: This prospective study was conducted in 127 contactable pregnant employees of a total of 153 midwives and nurses, between March 2013 and August 2014 in the province of Tekirdag, Turkey. These women were interviewed twice before their children were born, and the mothers and their newborn infants were then followed-up via a third interview.

Results: A total of 46.5% of the 127 pregnant and nurses developed a vagina haemorrhage complication during their pregnancy, 11.0% had a spontaneous abortion and 20.5% had given birth prematurely. It was determined that those respondents who experienced vaginal haemorrhages during their pregnancy period and those who gave birth prematurely had had statistically significantly higher exposure to certain risk factors, such as working while standing up and working overtime ($p < 0.05$).

Conclusion: This study showed that some occupational characteristics of pregnant nurses are effected on mother and fetus. The protection and support of pregnant healthcare professionals within their working environment, and the development of appropriate strategies in this regard in particular, must be highlighted and addressed.

Keywords: Nurse, Midwife, Occupational risks, Pregnant health workers, Pregnancy, Reproductive system, Spontaneous abortion.

Introduction

Women are defined as a particular risk group with regard to occupational health and safety, and are under protection within the work environment, due to the negative impact that occupational risk factors may have on fertility-related variables (Bilir & Yildiz 2013). Therefore, the protection and support of pregnant healthcare professionals within their working environment during pregnancy and particularly the development of appropriate

strategies in this regard, must be considered (Salihu et al. 2012).

Healthcare institutions pose significant risks with regard to the health and safety of employees. Indeed, it has been shown that the health and safety risks faced by healthcare professionals are more than those associated with all other industries (Aldem et al. 2013, Beyzadeoglu & Cengiz 2013, Ince 2008, Mollaoglu et al. 2010). Specifically, while nurses/midwives are responsible for the

constant and 24-hour care of patients, which forms an important majority of healthcare services, they are also exposed to a variety of risks and dangers that arise from the characteristics of the service. (Bilir & Yildiz 2013, İnce 2008, Mollaoglu et al. 2010).

Moreover, according to previous studies, certain occupational risks posed by the healthcare industry affect the human reproductive system (Alex 2011, Figa-Talamanca 2006, Mengeot & Vogel 2008, Salihu et al. 2012). Throughout pregnancy, embryos and fetus are especially sensitive to toxic substances, and the placenta does not provide a secure barrier against all of these. The form, and level, of sensitivity changes during the different periods of gestation, and it is during the embryonal period that organs begin to form. In addition, exposure to risk factors begins the moment that pregnancy is confirmed (Alex 2011, Bilir & Yildiz 2013, Bonzini et al. 2009, Salihu et al. 2012).

When women are exposed to occupational risk factors at their places of work during pregnancy, spontaneous abortion, stillbirth, premature birth intrauterine growth retardation and congenital anomalies may occur, and certain malignant diseases may develop during childhood. Certain psychosocial risk factors originating from the workplace environment (shiftwork, stress etc.) may also lead to spontaneous abortion, premature birth and pregnancy-related complications (Alex 2011, Assadi 2013, Bilir & Yildiz 2013, Bonzini et al. 2009, Gul et al., 2014, Lawson et al. 2009, Lawson et al. 2012, Salihu et al. 2012, Torres-arreola et al. 2007).

Moreover, certain toxic substances to which the mother is exposed during pregnancy or after birth may be transferred to breast milk, and therefore pose a risk for the infant being fed with this milk (Mengeot & Vogel 2008). Previous studies have also asserted that the exposure of pregnant nurses and midwives to risk factors in their working environment may lead to the development of various problems, such as spontaneous abortion, premature birth, lowbirth-weight infants and intrauterine growth retardation (Alex 2011, Bonzini et al. 2009, Figa-Talamanca 2006, Jansen et al. 2012, Katz, 2012, Lawson et al. 2009, Lawson et al. 2012). The lack of sufficient number of studies

on this issue is also a significant drawback (Lawson et al. 2009, Lawson et al. 2012).

Aim

This study had two main aims:

1. To determine the working conditions of nurses and midwives and the occupational risks to which they are exposed during pregnancy, and
2. To detect the health-related problems associated with these risks that develop during pregnancy and to evaluate their impact on the health of newborn infants.

Research Hypothesis

H1: The working conditions of pregnant midwives and nurse in the province of Tekirdag, Turkey, and the occupational risk factors that they face, have effects on pregnancy and/or the health of newborns.

Materials and Methods

This is a prospective study, in which pregnant midwives and nurses were interviewed at least twice before childbirth, and then once after birth, which meant planning and executing at least total of three interviews.

Setting and Sample

The study was conducted in all of the public and private healthcare institutions in a city in the province of Tekirdag, Turkey, and the target population consisted of the midwives and nurses who were pregnant on March 1, 2013, and who had gone into labour or had had their pregnancy terminated by August 30, 2014. The criteria for study participation were determined as working in the same city, being a nurse/midwife, being pregnant and agreeing to participate. At the beginning of the study, it was determined that 1,712 nurses and midwives worked across the province, 1,228 of whom were nurses and 484 of whom were midwives. The total number of midwives and nurses who were pregnant during the time when the study was conducted was 153. Although the study targeted all of the individuals included in the population described, 26 of these individuals (17%) could not be reached for various reasons, such as being on duty, being on sick leave and being unwilling to participate in the study,

therefore 127 pregnant midwives and nurses took part, giving a general participation rate of 83.0% (Figure 1).

Measurement

The data of the research were collected through the sociodemographic forms and forms including occupational risks during the pregnancy period as well as forms of postnatal period, neonatal babies and forms including institutional features of the working places. Study data were collected using survey forms prepared by the researchers pursuant to the examination of the relevant literature (Alex 2011, Bilir & Yildiz 2013, Bonzini et al. 2009, Burdorf et al. 2011, Canbaz et al. 2005, Garcia et al. 2012, Jansen et al. 2010, Lawson et al. 2009, Lawson et al. 2012, Salihu et al. 2012).

The Statistical Package for Social Sciences for Windows (version 20.0) program was used to statistically evaluate the study findings. Descriptive statistics methods (mean, standard deviation, median, maximum and minimum) and chi-square tests were also used in the analysis. In order to determine differences, a value of $p < 0.05$ was accepted as being statistically significant.

Data Collection Procedures

The study was carried out in three stages. During the first stage, the researchers met with the pregnant nurses and midwives who had agreed to participate in the study at the units where they were working. They were provided with information about the study, and asked to complete the Data Collection Form Regarding the Descriptive Characteristics of Pregnant Midwives and Nurses and Occupational Risks and the Data Collection Form Regarding the Healthcare Problems Developed by Midwives and Nurses during Pregnancy. The participants were informed that they would be assessed via questionnaire both prior to and after childbirth. They were asked not to write their names on the survey forms, and were codified using nicknames or numbers. However, telephone numbers were collected to enable completion of the data collection form regarding the postpartum periods of the participants and their newborn infants. In the same manner, the participants were provided with the contact information of both researcher in written form, and were informed that they could use this information

to access the researchers at any time. The data forms were completed in 35–45 minutes. During the second stage, those participants whose pregnancy had continued prior to birth were interviewed at their worksite or on the telephone if they were not present at their worksite and the relevant survey forms were completed. As part of the third stage, those participants who gave birth were interviewed during a visit to the hospital, or on the phone (within the first 2 weeks postpartum), and the Data Collection Form Regarding Postpartum Periods of Pregnant Midwives and Nurses and Newborn Infants was completed. The telephone interview lasted for 15 minutes.

Ethical considerations

The ethical approval for the research was granted by Trakya University Medical Faculty Ethics Board (Reference number: 03/01) on January 30, 2013. Permission was obtained from the relevant institutions in writing, the participants were informed about the study prior to its initiation, and their written and verbal consents were obtained.

Results

Working Conditions and Occupational Risks

A total of 71.7% of the pregnant healthcare workers in this study were nurses, while 28.3% were midwives. The average age of the group was 30.2 ± 4.6 years (minimum 21, maximum 43 and median 30).

Of the participants, 53.5% had undergraduate degrees, 22.8% were graduates of medical vocational high schools, 16.5% ($n=21$) had a college degree and 7.1% had post graduate degrees. It was observed that 94.5% of the participants worked at a public institution, 85% were among permanent staff, 65.4% worked at state hospitals, 17.4% worked at a university hospital and 17.2% worked in primary health care centre.

As it was found that 47.3% of the participants worked in shifts, 30.7% did not work in shifts, due to pregnancy, and 37.8% had excessive weekly working hours (more than 40 hours per week), weekly working hours were calculated as being an average of 48.4 ± 5.2 hours (minimum 45, maximum 68 and median 45 hours).

Moreover, it was observed that 76.4% of the participants had been assigned night duty during the first 24 weeks of their pregnancy, and that 75.6% generally worked while standing up (more than 6 hours per day); the time that was spent standing up was an average of 6.96 ± 3.9 hours (minimum 2, maximum 22 and median 6 hours) (Table 1).

Of the participants, 88.2% did not consider their working environment safe and 52% believed that the occupational risks they faced would have an effect on the fetus they were carrying. According to the participants' own statements, 89.8% respond that they were exposed to occupational risks within their working environment, primarily via biological risk factors (86.6%), and they also frequently encountered physical (noise, radiation etc.), chemical (disinfectants, anaesthetic gases etc.), ergonomic (lifting heavy weights etc.) and psychosocial (violence etc.) risks at the units where they were working (Table 1).

It was found that 26.0% of the participants had had at least one occupational accident during their pregnancy, and when the types of these accidents were examined, it was revealed that 3.9% had fallen down and/or slipped, and 22.1% had had a needle-stick injury. In addition, 92.9% of the participants had been vaccinated against hepatitis B, one of the participants carried hepatitis B and only seven (5.5%) had had a flu vaccination.

Obstetrical Characteristics

The average number of pregnancies of the participants was 1.7 ± 1.03 (minimum one, maximum seven, median two), while 49.6% were pregnant with their first child, 34.6% with their second child and 15.8% with their third or more child ($n=20$). Of the participants, 27.6% stated that they had had difficulty conceiving, 9.4% had benefited from assisted reproductive techniques, four had been impregnated with inoculation and eight participants had been impregnated via in vitro fertilisation (Table 1).

During the follow-ups that the participants regularly attended, the babies of 37% women did not carry any risks, whereas 15.7% were determined to be facing risks within the screening tests and seven participants were subject to perinatology examination together with

amniocentesis. It was stated that one participant had terminated her pregnancy upon the family's request following the amniocentesis result. It was found that 65.4% of the participants developed at least one pregnancy complication (vaginal haemorrhage, eclampsia, preeclampsia, gestational diabetes, oligo hydroamniotic ...) 46.5% had a vagina haemorrhage complication and 11% were hospitalized as a result of these complications (Table 1).

When the working group was evaluated after being classified into two groups, as those participants experiencing pregnancy complications and those not experiencing pregnancy complications, depending on occupational risk factors, it was found that those who had developed complications during pregnancy had greater exposure to risk factors, such as disinfectants ($p= 0.037$), anaesthetic gases ($p= 0.012$), stress ($p= 0.003$), lifting heavy weights ($p=0.032$) and being under stress ($p=0.003$). Among other risks, there was no statistically significant association between risks and pregnancy complications (Table 2).

The likelihood of experiencing pregnancy complications was significantly higher for those participants who worked overtime during pregnancy ($p=0.023$) and those who worked standing up for most of the time (more than 6 hours per day) ($p=0.007$).

It has been determined that the most developing complication at the gestation period of nurses and midwives is vaginal bleeding.

It has also been found out that vaginal bleeding increases for nurses and midwives at gestation period who are exposed to disinfectants, are distressed ($p=0.009$), and are to carry heavy things ($p=0.044$) due to the type of their workplace.

In addition to all above mentioned factors, it has also been determined that the rate of undergoing vaginal bleeding increases for subjects whose working period is more than 40 hours per week ($p=0.005$), who have shift work ($p=0.003$) or work at standing position for more than more than 6 hours a day ($p=0.003$) (Table 3).

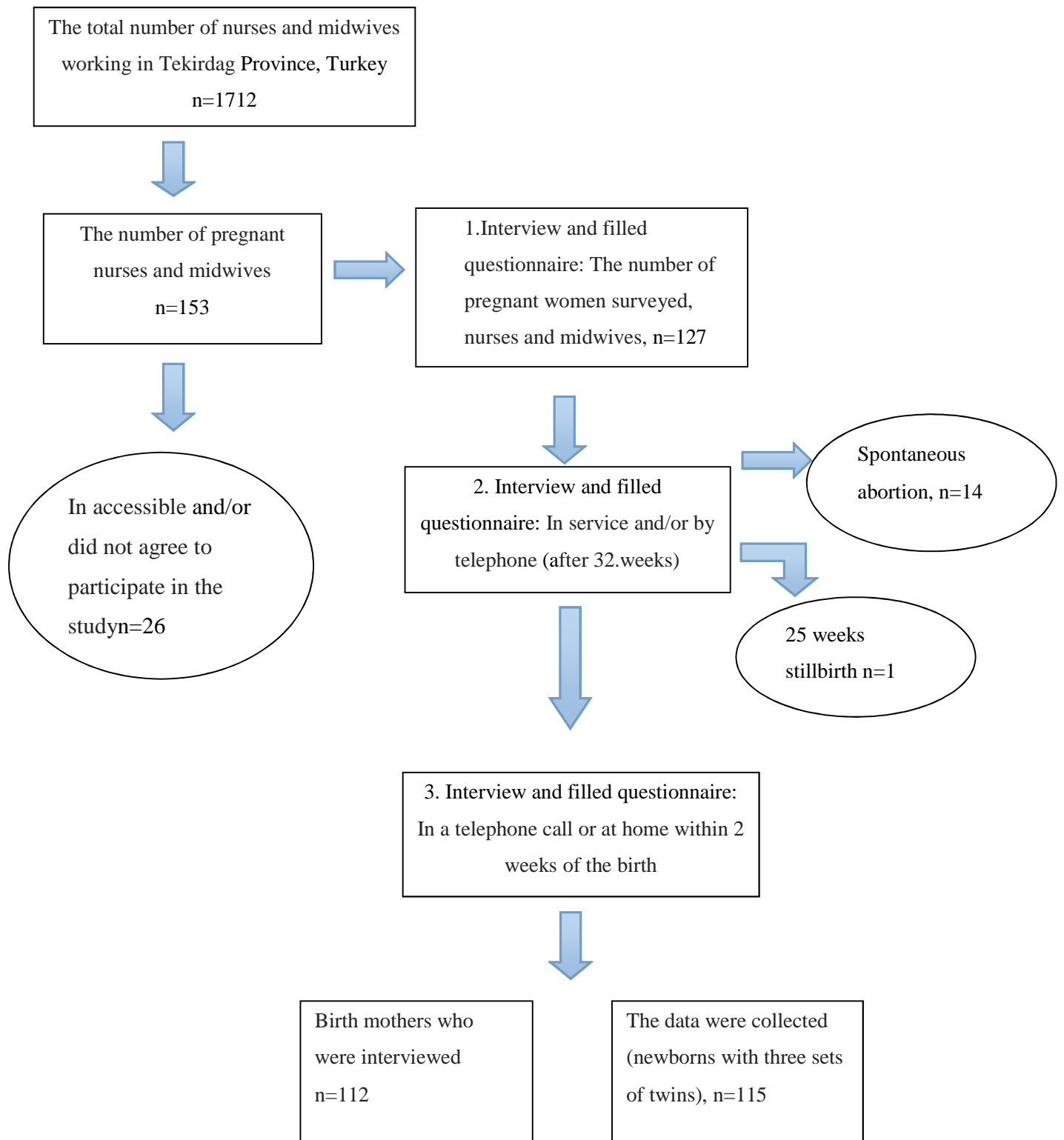


Figure 1. Research Process for this Study

Table 1. Working Characteristics of Pregnant Midwives and Nurses (n=127)

Working Conditions and occupational risks	n/Mean±SD*	%
Age		
Mean ± SD	30.2 ±4.6	
Job		
Nurse	91	71.7
Midwife	36	28.3
Shiftwork		
Yes	60	47.3
No	28	22.0
Did not work in shifts due to pregnancy	39	30.7
Night duty during the first 24 weeks of their pregnancy		
Yes	97	76.4
No	30	23.6
Excessive weekly working hours,		
Yes	48	37.8
No	79	62.8
Standing time/hours (a daily work)		
Mean ± SD	6.96±3.9	
Exposure to occupational risks		
Yes	114	89.8
No	13	10.2
Biological risks	101	86.6
Physical risks		
Noise	73	57.4
Temperature	17	13.4
Radiation	45	35.4
Air/stuffiness	96	75.6
Chemical risks		
Disinfectants	70	55.1
Chemotherapy drugs	16	12.6
Anesthetic gases	19	15.0
Latex	40	31.5
Ergonomic risks		
Bending/kneeling	97	76.4
Heavy lifting	53	41.7
Psychological risks		
Stress	93	73.2
Violence	23	18.1
During pregnancy, work accidents		
Yes	33	26.0
No	94	74.0

* = Mean ± Standard deviation

Table 2.Obstetrical Characteristics of Pregnant Midwives and Nurses (n=127)

Obstetrical Characteristics	n/ Mean±SD	%
The number of pregnancies *	1.7±1.03	
Number of children *	0.48±0.61	
Assisted reproductive techniques		
Inoculation	4	3.1
Vitrofertilization	8	6.2
Risks identified in the screening test		
Yes	20	15.7
No	95	74.8
Pregnancy complication		
Yes	83	65.3
No	44	34.7
Hemorrhage during pregnancy	59	46.5
After 32 weeks mandatory rest		
Yes	17	13.4
No	110	86.6
Pregnancy outcomes		
Spontaneous abortion	14	11.0
Live births	112	88.2
Stillbirth	1	0.8
Twins	3	2.6
Early birth		
Before 37 weeks	23	20.5
And after 37 weeks	89	78.8
Neonatal death		
Yes	2	1.7
No	113	98.3
Newborn weight (gram-gr)		
2500 and ↓	12	11.6
2501 ve 3000	25	21.7
3001 ve 3500	52	45.1
3501 ve 4500	24	22.6
4501 ve ↑	2	1.7
Hospitalized In intensive care	24	20.8
Intubated	5	4.3
Congenital anomalies	5	4.3

* = Mean± Standard deviation

Table3.Pregnant and neonatal characteristics according to some occupational risks and working characteristics of nurses

Risks		Pregnancy complications*		Vaginal hemorrhage		Spontaneous abortus		Early birth (37< week)		Low birth weight (2500gr ↓)	
		Yes N (%)	No N (%)	Yes N (%)	No N (%)	Yes N (%)	No N (%)	Yes N (%)	No N (%)	Yes N (%)	No N (%)
Noise	Yes	36(63.2)	21(36.8)	28(49.1)	29(50.9)	7(12.3)	50 (87.7)	10(20.0)	40(80.0)	6(10.7)	46(89.3)
	No	47(67.1)	23 (32.9)	29(41.4)	41(58.6)	7(10.1)	62 (89.9)	13(21.0)	49(79.0)	6(9.5)	57(91.5)
		p=0.388		p=0.246		p=0.460		p=0.545		p=0.479	
Raditation	Yes	34(74.0)	12(26.0)	25(39.5)	21(45.6)	5 (10.2)	40(89.8)	13(32.5)	27(67.5)	10(23.8)	32(66.2)
	No	49(60.5)	32(39.5)	32(39.5)	49(60.5)	9 (11.1)	72(88.9)	10(13.8)	62(86.2)	2(2.7)	71(97.3)
		p=0.090		p=0.076		p=0.624		p=0.012		p=0.001	
Anestheticgases	Yes	17(89.5)	2(10.5)	11(57.9)	8(42.1)	3(15.8)	16(84.2)	4(20.0)	12(75.0)	9(39.1)	14(60.9)
	No	66(56.1)	42(38.9)	46(42.6)	62(57.4)	11(13.7)	69(86.3)	19(25.0)	77(80.2)	3(3.2)	89(96.8)
		p=0.012		p=0.162		p=0.354		p=0.425		p=0.000	
Disinfectants	Yes	51(72.9)	19(27.1)	38(54.3)	32(45.7)	7(10.1)	62(89.9)	13(21.0)	49(79.0)	8(12.6)	55(87.4)
	No	32(56.1)	25 (43.9)	19(33.3)	38(66.7)	7(11.6)	50(88.1)	10(20.0)	40(80.0)	4(7.8)	47(92.2)
		p=0.037		p=0.014		p=0.460		p=0.545		p=0.310	
Chemothera- pydrugs	Yes	10(62.5)	6(37.5)	6(37.5)	10(62.5)	1(6.2)	15 (93.8)	5(50.0)	10(50.0)	2(13.3)	13(86.7)
	No	73(68.5)	38(34.2)	51(45.9)	60(54.1)	13(11.8)	97 (88.1)	18(19.3)	79(80.7)	10(10.0)	90(90.0)
		p=0.501		p=0.360		p=0.441		p=0.183		p=0.485	
Stress	Yes	68(73.1)	25(26.9)	48(51.6)	45(48.42)	12(13.0)	80(87.0)	8(18.7)	65(81.3)	9(23.6)	29(76.4)
	No	15(44.1)	19(55.9)	9(26.5)	5(73.5)	2(5.9)	32(94.1)	15(25.0)	24(75.0)	3(3.9)	74(96.1)
		p=0.003		p=0.009		p=0.212		p=0.310		p=0.559	
Heavylifting	Yes	40(75.4)	13(24.6)	29(54.7)	24(45.3)	4 7.7)	48 (92.3)	12(25.0)	36(75.0)	9(20.9)	43(79.1)
	No	43(55.4)	31(44.6)	28(37.8)	46(62.2)	10(13.5)	64(86.5)	11(17.2)	53(82.8)	3(4.8)	60(85.2)
		p=0.032		p=0.044		p=0.234		p=0.218		p=0.029	
More than 40 hours per week	Yes	37(77.1)	11(22.9)	29(60.4)	19(39.6)	9(64.2)	38(33.9)	12(31.6)	26(68.4)	5(12.5)	35(87.5)
	No	46(58.1)	33(41.8)	28(35.4)	51(64.6)	5(35.8)	74(66.1)	11(14.9)	63(85.1)	7(9.5)	67(91.5)
		p=0.023		p=0.005		p=0.029		p=0.030		p=0.435	
Shiftworkers	Yes	43(71.7)	17(28.3)	35(58.3)	25(41.7)	11(78.5)	48(42.8)	15(31.2)	33(68.8)	10(19.2)	42(80.8)
	No	40(59.7)	27(40.3)	22(32.8)	45(67.2)	3(21.5)	64(57.2)	8(12.5)	56(87.5)	2(3.2)	61(96.8)
		p=0.110		p=0.003		p=0.012		p=0.014		p=0.006	
Standingtime/ho urs (more than 6 hours per day)	Yes	69(71.9)	27(28.1)	50(52.1)	46(47.9)	12(85.7)	83(70.1)	22(26.5)	61(73.5)	10(12.0)	73(88.0)
	No	14(45.2)	17(19.4)	7(22.6)	24(77.4)	2(14.3)	29(29.9)	1(3.4)	28(96.6)	2(6.2)	30(93.8)
		p=0.007		p=0.003		p=0.278		p=0.005		p=0.295	

* Vaginalhemorrhage, eclampsia, preeclampsia, gestationaldiabetes, Fisher'sExact Test, p<0.05, Chi-square, p<0.05.

Table 4.Characteristics of Newborn According toThe Radiation Risk During Pregnancy

Newborn characteristics		Radiation risks				p**
		Yes		No		
		N	%	N	%	
	2500 ↓	9	22.0	2	2.7	
Newborn weight (gr)	2501 ve 3000	7	17.0	18	25.0	
	3001 ve 3500	17	41.5	34	47.2	0.011*
	3501 ve ↑	8	19.5	18	25.0	
	Total	41	100.0	72	100.0	
Inintensive care	Yes	14	63.6	26	28.9	
	No	8	36.4	64	71.1	0.003
	Total	22	100.0	90	100.0	
Newborn intervention	Yes	19	61.3	21	25.9	
	No	12	38.7	60	74.1	0.001
	Total	31	100.0	81	100.0	

Fisher'sExact Test, *p<0.05. Chi-square.**p<0.05.

Postpartum Characteristics

A total of 88.2% (n=112) of the 127 participants had a live birth, 11.0% (n=14) had a spontaneous abortion and one participant had her pregnancy terminated with stillbirth at a state hospital during their 25th week and 2 days of the pregnancy, due to a health problem detected in the fetus. During pregnancy, 19.2% of those participants who had higher weekly working hours (more than 40 hours per week) and 18.7% of those working in shifts had spontaneous abortion. Accordingly, spontaneous abortion rates of the participants with a higher number of weekly working hours (p=0.029) and those working in shifts (p=0.012) were

significantly higher than those of the participants who did not work under these conditions. Similar results were obtained for the participants who primarily worked standing up during pregnancy (p>0.05) (Table 3).

It was found that 20.5% of the 112 participants who had a live birth had given birth before week 37. When our participants were examined with regard to premature birth and working conditions, it was found that those who worked overtime had higher rates of premature birth compared to those who did not work overtime (p=0.030), and those working shifts had higher premature birth rates than those who did not (p=0.014). Of the premature

births, 26.5% occurred in those participants who claimed to be working while standing up (more than 6 hours per day) during most of their working hours ($p < 0.05$) (Table 3).

Three of the live births (2.6%) were twin babies and 53.1% were baby boys while 46.9% were baby girls.

During the postpartum period, two of 115 newborn infants (1.7%) died during the early neonatal (0-7 days) period: one died on the second day, due to a heart anomaly, and the other died on the fifth day, due to respiratory distress syndrome (lung surfactant deficiency) (Table 2).

Of the newborn infants, 45.1% were born weighing between 3,001g and 3,500g, while 11.6% were 2,500g and below and two newborn infants (1.7%) weighed 4,500g or above. A total of 71.3% of the newborn infants did not require any intervention after birth, 24.3% were given only oxygen ($n=28$), and five (4.3%) were intubated. Moreover, during the first hour after birth, 73.0% of the babies were fed with breast milk.

A total of 20.8% ($n=24$) of newborn infants were hospitalized in a newborn intensive care unit, and five (4.4%) were found to have congenital malformation (Table 2).

When the impact of the risk of the participants exposure to radiation within their working environments on the newborn infants was evaluated, it was found that nine (81.8%) of 13 newborn infants with low birth-weight were the babies of those participants who had stated that they had been exposed to radiation. It was specified that 14 (63.6%) of the babies of those mothers who had been exposed to radiation were hospitalised in the intensive care unit, and 19 (61.3%) received an intervention after birth. In all, 18 (51.4%) of the newborn infants of those participants who had faced a radiation risk were included in the risky newborn group, whereas this figure was 28 (21.0%) among the babies of those participants who had not faced any risk of radiation. The radiation risk was particularly significant ($p < 0.05$) with regard to the weight of the newborn ($p=0.011$), hospitalize in an intensive care unit ($p=0.003$), and intervention after birth ($p=0.001$) (Table 4).

In this study, it has been indicated that the newborn babies of nurses and midwives working during gestation period and are exposed to radiation ($p=0.001$) and anaesthetic gas ($P=0.000$) mostly weigh less than 2500gr↓. Besides, it has also been determined that the newborn babies of subjects who have shift work ($p=0.006$) or are to carry heavy objects (0.029) at their workplace have also low birth weight (Table 3).

Of the study participants, 90.3% ($n=102$) did not develop any health problems during the postpartum period, while 9.7% ($n=11$) encountered various health-related problems. Two (1.9%) of the participants who gave birth were hospitalized in intensive care units as a result of the health problems they developed.

Discussion

Morbidity and mortality statistics in the maternal, fetal and neonatal periods are considered to be some of the most important indicators of the sophistication of healthcare institutions or a healthcare system (Atasayar, 2015). According to the 2013 results of the Population Survey of Turkey study (TNSA), which is repeated throughout the country every 5 years, 19 of every 100 pregnancies end in miscarriage (TNSA 2013). Of every 100 pregnancies, 14 are spontaneous abortion and five are intentional miscarriages, and one of every 100 pregnancies is a stillbirth. Each year, 1.3 million babies are born in Turkey, and research has shown that 10% of them are considered underweight. In other words, 140,000 underweight babies are annually born in the country. According to the 2012 'Global Action Report about Premature Birth' report by the World Health Organization, the rate of premature births is around 5–18%, and is 11.97% in Turkey (Atasayar 2015). Preterm births are an important consequence of risky pregnancies; the earlier in the pregnancy, the higher the number of problems experienced by the baby, leading to early and late morbidities (Kavuncuoglu, 2010). According to TNSA 2013 data, of every 1,000 live births, the mortality rate is 15, the baby death rate is 13 and the neonatal death rate is seven (TNSA, 2013). Looking at the global geography in terms of childhood deaths, we see that Africa and Asia have high death rates, whereas Europe and North

America have the lowest death rates (Atasayar 2015).

Due to its significance, belonging to the general population outside these data, whereas in our country, there aren't any studies with a scope identical to our research among healthcare professionals and it is observed that there are only a few studies in this field which examine some of these parameters.

Previous studies have highlighted the fact that the exposure of healthcare workers to risk factors in their working environment during pregnancy may lead to the development of various health problems, such as spontaneous abortion, premature birth, low birth-weight infants and intrauterine growth retardation (Alex 2011, Bilir & Yildiz 2013, Bonzini et al. 2009, Figa-Talamanca 2006, Jansen et al. 2010, Katz 2012, Lawson et al. 2009, Lawson et al. 2012). A variety of studies carried out in healthcare workers have shown that risk factors such as radiation, anaesthetic gases, anti-neoplastic drugs, infections and standing up for long periods while working affected the pregnancies and the results of the subsequent births (Alex 2011, Assadi 2013, Yenal & Ozan 2013).

In the present study, the observed pregnancy-related complications and premature birth rates observed in midwives and nurses were higher than the average found in Turkey. Although pregnancy and birth are normal physiological processes, 10–20% of children who are born and 20–30% of pregnant women are in the risk group (Tiras et al. 2007). However, a study on mothers who gave birth prematurely revealed a pregnancy complication rate of 61.3%. The high rates found in our study could be due to the working conditions of nurses and midwives and occupational risks, and we believed that these should be regarded as risky pregnancies. It is important to implement the “safe motherhood” in order to reduce complications amongst mothers in the prenatal, natal and postnatal periods (Akın & Ozvaris 2012).

The current study found that the nurses and midwives who worked shifts, had night duties, worked standing up (more than 6 hours per day) and worked an excessive amount of weekly hours (more than 40 hours per week) during pregnancy

faced a higher number of pregnancy complications and had spontaneous abortions and premature births. Therefore, we can state that working conditions might have an impact on the health of the mother and the fetus. The present study is of vital importance, as it demonstrates the negative effects of a heavy workload and irregular work on pregnant employees and the health of the fetus. The International Council of Nurses indicated that those nurses who work excessively and intensively would face negative effects on their health, and the working conditions experienced could have an adverse impact on family and social life and occupational diseases, and work-related injury risks would increase (ICN). Quansah and Jaakkola examined PubMed publications between 1966 and 2009 and found that four different case-control studies showed that shift work led to spontaneous abortion (Quansah & Jaakkola 2010). Lawson et al. examined occupational risk factors and premature birth and spontaneous abortion in nurses and midwives separately, and found that the risk of spontaneous abortion increased in those nurses who worked 41 hours and more in one week, and that the risks of premature birth and spontaneous abortion increased in those working between 21 and 40 hours a week, compared to those working less than 20 hours a week (Lawson et al. 2009, Lawson et al. 2012). In their study, Jansen et al. determined that the birth weight of the babies of those mothers working more than 40 hours a week were lower than those of the babies born to the mothers working between 1 and 24 hours (Jansen et al. 2010). In conclusion, it can be claimed that premature births are higher among working groups and that the difference is related to the sampling groups.

The present study found that spontaneous abortion, pregnancy-related complications and premature birth rates in participants who declared that they had been exposed to occupational risk factors, such as radiation, anaesthetic gases, disinfectants, heavy lifting and stress, at the clinics where they were working, were statistically significant. Although one study found that exposure to X-rays increased foetal loss during early pregnancy, and despite it revealing significance at the limit values, it was asserted that radiation is related to spontaneous abortion and premature births (Lawson et al. 2009,

Lawson et al. 2012). Previous studies have shown that disinfectants have an adverse effect on the reproductive system (Alex 2011, Ayoglu et al. 2005, Mengeot & Vogel 2008). Our study determined that the participants using disinfectants had developed higher rates of pregnancy complications, and in particular they encountered a higher number of haemorrhage problems ($p < 0.05$). According to the established literature, vaginal bleeding during pregnancy is a risk factor for spontaneous abortion and premature birth (Ulug 2006). In addition to our findings, Lawson et al. concluded from two different studies that nurses who are in contact with steriliser substances, such as glutaraldehyde, formaldehyde and ethylene oxide, had an increased number of premature births and spontaneous abortion (Lawson et al. 2009, Lawson et al. 2012). In a study conducted with anaesthetists, Ogun et al. found that eight of 70 pregnancies ended with a miscarriage, eight of the children born had congenital anomalies and severe health problems and 18 newborn infants had a low birth-weight (Ogun & Cuhruk 2001). Quansah and Jaakkola claimed that anaesthetic gases have an effect on spontaneous miscarriage and congenital malformations (Quansah & Jaakkola 2010), while another study specified that premature birth and spontaneous abortion rates increased in those nurses who had been exposed to anaesthetic substances (Lawson et al. 2009, Lawson et al. 2012). The results are in accordance with one another and they are significant in terms of showing that employees who plan to get pregnant, and who are pregnant, should not be employed in risky working areas.

The rate of spontaneous abortion in our study participants was 10%, which is similar to the rate observed in the study conducted by Lawson et al., who found that the spontaneous abortion suffered by nurses and midwives originated from occupational risk factors and working conditions. In the same study, the authors determined that age, parity, weekly working hours (more than 40 hours per week), shift work status and occupational risk factors, such as radiation, anti-cancer drugs, anti-viral pharmaceuticals, anaesthetic gases and sterilisation substances were statistically significant for the working participants (Lawson et al. 2009, Lawson et al. 2012). Similarly, in our study, a

statistically significant difference was observed among the participants with excessive weekly working hours and those working shifts, whereas working while standing and night work were not statistically significant. We believe that the statistical significance related to spontaneous abortion due to similar working conditions discussed in both studies is of vital importance.

It is generally difficult for a pregnant nurse to avoid the teratogenic and fetotoxic risks and dangerous situations in their working environment. Therefore, pregnant healthcare workers at hospitals should be considered as vulnerable personnel (Alex 2011, Katz 2012) and the requisite protective measures must be taken (İnce 2008). Moreover, when a pregnant nurse suffers from the loss of a fetus, occupational risk factors should definitely be considered (Alex 2011, Katz, 2012). When the characteristics of the newborn infants of pregnant nurses and midwives are examined, the detection of early neonatal deaths, premature births, low birth-weight babies and congenital anomalies is considerably important part of the study. It was found that premature and congenital anomalies in particular lead to the loss of newborns during the early neonatal period (Taskin 2011, TNSA 2013). When neonatal deaths and the rates in different countries are examined, it is thought-provoking to observe that the deaths of these infants cannot be prevented during the general development level, and that they generally resulted from similar reasons. In our study, the early neonatal mortality rate was 17%, which is considerably higher than the average in Turkey (TNSA 2013). This suggests that these pregnancies can be regarded as risky pregnancies.

Several studies have shown that radiation, which is an important risk for healthcare workers, has adverse effects during pregnancy (Salihu et al. 2012, Smedly et al. 2007). Ionising radiation in particular may lead to teratogenic effects, fetotoxic effects, carcinogenesis, germ-cell mutation and genetic effects in the fetus (Adali & Adalı 2008, Bakkal & Sayin 2012). The studies carried out state that if sufficient amount of radiation exposure is in question during pregnancy, the risk of miscarriage and stillbirth increases, congenital disease risk may develop in the fetus, and

malformation, growth retardation, neurobehavioral disorders and the development of childhood cancer may increase (Adali & Adali 2008, Alex 2011, Bilir & Yildiz 2013, Groen et al. 2012, Salihu et al. 2012). A statistically significant relationship was determined between working conditions (night work, more than 6 hours a day, is more than 40 hours per) and radiation exposure in premature births. In order to protect the health of the mother and the fetus, it is of particular importance to provide suitable working conditions for those healthcare workers who plan to get pregnant and/or are pregnant and to conduct the necessary tests in these workers.

Conclusion

The present study revealed that certain working conditions and occupational risks encountered by pregnant women led to higher risks of spontaneous abortion, premature birth, low birth-weight, at-risk newborn infants, pregnancy-related complications and vagina haemorrhages, and that the difference between these was statistically significant. The findings of our study are compatible with those in the literature (Bilir & Yildiz 2013, Bonzini et al. 2009, Jansen et al. 2010, Lawson et al. 2009, Lawson et al. 2012, Salihu et al. 2012) and it is important in terms of demonstrating that the working conditions and occupational risks encountered by healthcare workers have an impact on the pregnancy process and result in adverse effects on the health of newborn babies. The protection and support of pregnant healthcare professionals within their working environment, and the development of appropriate strategies in this regard in particular, must be highlighted and addressed.

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