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Long Working Hours and Pregnancy Complications among Residents

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Review Article

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ABSTRACT

Residents of Internal Medicine, General Surgery, Psychiatry, Emergency Medicine, and Obstetrics and Gynecology work around 80 hours per week in their residency years. Residency training is physically demanding and highly stressful, and can become even difficult if the female resident is pregnant. It is a well-known physically strenuous occupation that has also been suspected to show negative pregnancy outcomes if the resident becomes pregnant during her residency years. The long working hours not only increases the chance of pre-term delivery, but also of other adverse outcomes such as abruptio placenta, low birth weight, intra-uterine growth retardation. From the last decade, between the years 1990-2000, the number of female medical students and these female residents has shown a dramatic increase, from 30% to almost 40%. Because of the pressure of increasing age, and fertility concerns, most of the physicians choose child bearing during their early residency years. This review article expands the understanding of long working hours during residency training and its association with pregnancy complications and adverse pregnancy outcomes. A design of a retrospective study is also proposed in the article, to determine the association of adverse pregnancy outcomes among residents according to the latest ACGME work hour guidelines.

INTRODUCTION

Physical exhaustion, anxiety, stress, and sleep deprivation are common in the life of a physician. Residents of Internal Medicine, General Surgery, Psychiatry, Emergency Medicine, and Obstetrics and Gynecology work around 80 hours per week in their residency years. Residency training is physically demanding and highly stressful, and can become even difficult if the female resident is pregnant. The long working hours, sleep deprivation, anxiety, work stress, night duties, can affect the pregnancy outcomes.

Some of the important factors that can lead to an adverse pregnancy outcome include excessive physical and mental strain, depression, and sleep deprivation among pregnant females^[1].

Physical activity during pregnancy is found to result in numerous health benefits, such as maintaining healthy pregnancy weight, less muscular discomforts, and maintenance of blood pressure and blood sugar levels^[2]. However excessive physical and emotional stress during pregnancy is found to show highly negative outcomes on pregnancy^[3].

It is estimated that about 3-17% of pregnant females suffer from mental anxiety and depressive symptoms during pregnancy, that not only affects their social and personal life, but can also harm the baby^[4,5]. A study from Sweden reports that about 40% women suffer from moderate level of anxiety and depression, the most common age group being 18-29 years of age^[6]. There are significant associations observed between anxiety and depression during pregnancy and increased complications such as nausea, vomiting, and even pre-eclampsia. A connection between antenatal anxiety and post-partum depression is also found^[7]. Also, excessive physical and mental anxiety between 12-22 weeks of pregnancy can lead to ADHD (Attention Deficit Hyperactive Disorder) in the baby^[8]. It is also an established fact that if the mother has depression or is involved in excessive physical activity

during the antenatal period, the outcome of pregnancy can be an early delivery resulting in premature baby, and lower birth weight infant^[9,10].

Sleep deprivation has also become a major issue among pregnant females nowadays. During pregnancy, the duration of sleep increases, with total increase in sleep time and daytime sleepiness in the first trimester^[11]. A study from Finland has reported that total sleep time increases during the first trimester, and remains same as the antepartum period in the second and third trimester of pregnancy^[11]. Sleep deprivation even in the non-pregnant state can have harmful effects on the cognitive functions overtime, leading to errors in workplace, changes in endocrine functioning, and other functional deficiencies^[12]. A prospective cohort explains that sleep disturbance and fatigue in later half of pregnancy may even effect the duration of labor and type of delivery^[13]. In specific, sleep deprived women during their pregnancy experience longer duration of labor, more severe and painful contractions, and high rate of preterm birth and C-sections^[14]. This review article expands the understanding of long working hours during residency training and its association with pregnancy complications and adverse pregnancy outcomes. A design of a retrospective study is also proposed in the article, to determine the association of adverse pregnancy outcomes among residents according to the latest ACGME work hour guidelines.

LITERATURE REVIEW

Developmental birth defects, structural anomalies, growth restrictions and preterm birth account for about 25% of morbidity and mortality among newborns^[15]. Studies have documented that maternal environmental exposures, physical exhaustion, and stressful lifestyle can show significant impact on the developing fetus and may result in negative birth outcomes such as preterm delivery, and congenital anomalies^[16,17]. For working mothers, certain job related stresses, such as long job hours, prolong periods of standing and mental stress can show adverse effects on their pregnancy outcomes. A meta-analysis by Mozurkewich et al.^[18] combined the results of 29 studies and reported that the job that require long working hours and are physically demanding increases the chances of preterm delivery of the child (OR 1.22; 95% CI 1.16-1.29), and pre-eclampsia (OR 1.60;95% CI 1.30-1.96)^[18]. A review article by Bonzini et al.^[19] supports a strong association between long standing hours, shift work; prolong job hours, and lifting heavy load with adverse fetal outcomes like preterm birth, low birth weight, and pre-eclampsia and hypertension^[19]. Similar results are supported by Claudia et al, where the study reports that women who work ≥ 40 hrs/week were found to have lower fetal weight and smaller head circumference^[20].

Medical Residency is a well-known physically strenuous occupation that has also been suspected to show negative pregnancy outcomes if the resident becomes pregnant during her residency years^[21,22]. Residents of Internal Medicine, OBGYN, General Surgery, Emergency Medicine, and Psychiatry perform duties for long hours during the day and night and work under high mental stress^[23]. From the last decade, during 1990-2000, the number of female medical students and these female residents has shown a dramatic increase, from 30% to almost 40%^[24,25]. In the year 2001, about 28% of the emergency medicine residents were females^[26]. It is a common trend among these male and female medical students and residents to find a partner and get married during their residency years. About 90% of male residents and 70% female physicians marry during their residency years and 50% of these are dual-physician marriages^[27-29]. Because of the pressure of increasing age, and fertility concerns, most of the physicians choose child bearing during their early residency years^[30,31]. According to American Medical Association survey, about 50% of the female physicians in all the specialties have their first pregnancy during residency (AMA, 1984). This highlights the importance of pregnancy outcomes in these mothers, who are devoted in such a physically demanding career.

There are a number of research studies that document the adverse effects of long working hours and physically demanding work during medical residency on the pregnancy outcome. A study conducted by Osborn et al, focused on 45 university affiliated community hospitals- residency programs and found that half of the female residents do one night duty per week (without sleep) during their first and second trimester, and 44% female residents reported one night duty per week in their third trimester^[32]. Also, these female residents were more likely to have pre-term birth compared to the wives of their male co-residents^[32]. Sleep deprivation was also studied by Klebnoff et al.^[23] among 4412 residents across the country, and it was found that the female residents not only suffer from sleep deprivation and perform long working hour shifts during pregnancy, but also end up having more cases of pre-eclampsia (8.8% vs. 3.5%) and preterm labor (11.0% vs. 6.0%) when compared to the spouses of the male residents of their department^[23]. Working almost 100 hours per week likely results in sleep deprivation, and it is observed that female residents who work more than 100 hours per week while also being pregnant have a 9.8% risk of pre-term delivery compared to 4.6% among residents who work less than 100 hours ($p=0.0002$)^[23]. The main mechanism of sleep deprivation, and poor quality sleep and adverse fetal outcome has been reported by Okun et al. Poor sleep in mid and late trimester can cause higher levels of pro-inflammatory cytokines such as IL-6, which may play a role in early onset of labor resulting in preterm birth^[33,34]. These inflammatory cytokines may also increase prostaglandin production and promote uterine contractions and labor. Also, studies have found an important association between sleep deprivation during pregnancy and post-partum depression^[35]. The possible mechanism is due to the inflammatory cytokines, which may be responsible for aggravating depressive symptoms during the post-partum period^[36,37].

The long working hours not only increases the chance of pre-term delivery, but also of other adverse outcomes such as abruptio placenta, low birth weight, intra-uterine growth retardation^[38]. A retrospective study by Schwartz reports a high rate of

abruptio placenta among pregnant physicians and medical students (ten times greater) and 12 % incidence of preterm labor^[38]. A survey study by Grunebaum includes 454 pregnant obstetricians, and reports 8.0 % increase incidence of intra-uterine growth retardation, and 11.6% increase incidence of low birth weight in their study population^[39]. The rates are just 2.6% incidence of low birth weight and just 1% incidence of intra-uterine growth restriction when babies are born to female physicians either before or after their residency training^[39]. The incidence of miscarriages and stillbirth, are however found to be low among female physicians when compared to the general population^[22].

An important study regarding female physician pregnancies was conducted by Miller et al. in the form of a matched cohort over a period of 10 years^[41]. The cohort was conducted at a university hospital and focused on adverse pregnancy outcomes among pregnant female physicians. Sixty-seven pregnant physicians were matched to 201 non-physician pregnant females for age, socioeconomic status, and ethnicity and due date of delivery. Potential confounders such as alcohol use, smoking and adequate prenatal care were controlled. The study defines its adverse outcomes as preterm births, low birth weight, preterm labor, abruptio placenta and perinatal mortality. The results of this study showed that the overall incidence of adverse outcomes was 1.8 times higher among physician pregnancies. This includes a 4.0 times increase risk of pre-term labor, which is defines as initiation of contractions and cervical ripening, and 2.3 times greater incidence of pre-term delivery. Physician pregnancies also showed a higher rate of meconium-stained amniotic fluid upon delivery. The rate of C-sections, labor complications, mean birth weight of newborns, and mean APGAR score however, was found to be similar in both groups^[41]. The incidence and severity of these unfavorable outcomes increased as the number of working hours and job stress increased^[21,40,41].

Longer hours of work shifts among residents also impose a huge mental stress compared to other career fields^[42,43]. The continuous psychological stress of providing a high quality patient care and minimizing errors poses an incomparable stress on a physician, and if a female physician becomes pregnant, an extra amount of stress is added on her body^[44,45]. Not only this, pregnancy of a fellow resident also becomes the cause of irritation among her co-residents and adds administrative difficulties as reported by Syres et al.^[31]. In this study, about 67% residents reported that their pregnancy created acrimony among her co-residents, and 57% reported to cause administrative issues^[31]. It is a well-known fact that psychological stress and emotional strain can also cause adverse pregnancy outcomes, the most common being the pre-term labor and delivery^[22,46-48]. The major mechanism by which stress causes harmful effects in a pregnant female is due to the chain of events mediated by high catecholamine levels due to emotional and physical stress^[49]. In addition to that, prolong periods of standing during work hours can cause postural effects on a pregnant body. This combination of high catecholamine levels and postural effects can reduce the uterine blood flow. Blood shunts to the lower extremities during prolong standing, reducing the cardiac output. All this can result in alteration of fetal heart rate, maternal blood pressure, and venous return to the heart, resulting in low birth weight fetus and other adverse outcomes^[50,51]. An interesting study by Timio et al observed high urinary levels of adrenaline and noradrenaline in pregnant females, and the increase is directly proportional to the level of psychological stress in the workplace^[52]. Excessive levels of catecholamines can cause vasoconstriction of uterine vessels, leading to intrauterine growth retardation and placental infarction^[1,53].

An interesting and more recent cross-sectional study from Hungary evaluated Physician burnout and its association with reproductive and pregnancy outcomes among female physicians^[54]. Burnout among physicians is defined as "the specific psychological condition that causes emotional exhaustion, depersonalization and negative feelings of lack of accomplishment"^[55].

The study reports that female physicians were found to have more than one year time-to-to pregnancy interval time when compared to general population (18.4% vs. 9.8%), they were more likely to have high risk pregnancies (26.3% vs. 16.3%), higher rates of miscarriages (20.8% vs. 14.6%) and infertility treatments (8.% vs. 3.4%)^[54]. Psychological burnout is found to be a strong risk factor for adverse outcomes of pregnancies^[54].

The complications in pregnancy due to prolong working hours has also been reported in a cross-sectional study from Japan^[56]. Out of 939 physicians participated in this study from Japan, about 12% reported Pre-term birth and 15% experienced threatened abortion. Women who worked ≥ 70 hours per week were found to have three fold increase risk of threatened abortion (95% Confidence Interval(CI): 1.7-6.0) and 2.5 times increase risk of preterm birth (95% Confidence interval (CI): 1.9-9.2), when compared with women who work ≤ 50 hours per week^[56].

MATERNAL LEAVE POLICIES IN RESIDENCY TRAINING

The policies regarding maternity leave varies widely among different specialties. A recent study reported the lack of program specific maternity leave policies in the departments of General Surgery and underlines the importance of generating any of such policies^[57]. A survey from several departments of OBGYN across the country reported that about 93% of OBGYN program requires make-up for lost time if their resident takes >20 weeks of leave. The department of pediatrics insists that about 6-8 weeks should be allowed for maternity leave (Paternal Leave for Residents and Pediatric Training Programs, 2013). Moreover, one surgery program requires its female residents to continue to work with full effort until they go into labor^[58]. Various articles in current literature emphasize the importance of maternity leave policies and its effect on not only the physician and her infant, but also on the medical training and quality of patient care^[59]. A study conducted by Satarri reports a direct relationship of duration of lactation with longer maternity leave, and not making-up for the left calls and duties. Another article supports this fact and reports a significant decline in premature birth and infant mortality, and an increase in infant weight when mothers are allowed at least 12 weeks of maternity

vacations, which is according to the Family and Medical Leave Act ^[60]. The Federal law mandates a total of 12 weeks of unpaid leave to the employee every year, with continued health insurance benefits during this vacation period ^[61]. Therefore, programs need to be in compliance with these federal policies to demonstrate best practice of infant-maternal health ^[62,63].

LIMITATIONS OF THE PREVIOUS RESEARCH

Various studies in the US and across the globe have observed the association of long duty hours and pregnancy outcomes among pregnant female residents. However most of the literature is from late 1980's and 1990's ^[1]. None of the studies have used a broad sample from residents of multiple specialties to expand the generalizability of the results ^[23]. Some studies have reported significant limitations of selection bias, due to confining their study to either only private or university based hospitals, and low participation rates. Sampling bias is another limitation reported by a study that reduces the external validity or generalizability of the results ^[56]. Most of the time, a recall bias becomes an issue because most of the studies that study the association of long working hours and adverse pregnancy outcome among female physicians are either case-control or retrospective cohorts ^[56].

PROPOSED STUDY DESIGN

With increased number of female residents in the program, greater numbers of pregnancies during residency, and with the changing guidelines of ACGME on resident duty hours, it is important to conduct a large study to evaluate the progress made and how the new policies have altered these important issues of adverse pregnancy outcomes. It is crucial to have current knowledge of this issue, so that the published literature can help in proposing further improvements in the residency work hours for pregnant females and maternity policies. The main hypothesis of this proposal is that the long working hours during the residency is associated with adverse pregnancy outcomes such as preterm birth, threatened abortion, and miscarriage, stillbirths, LBW, and SGA babies. This research proposal suggests studying the pregnancy outcomes of female residents who had given birth during residency training and compare it to the pregnancy outcomes of the wives of male residents who work for less than 80 hours per week.

The study should include about 500 female residents from the departments of internal medicine, OBGYN, general surgery, psychiatry, and emergency medicine. All the females who have been pregnant during the residency should be a part of the study. The comparison group of 500 should include the wives of male residents who work less than 80hours/week. Participants should be asked about the variety of adverse pregnancy outcome which in this study is pre-term delivery of the baby (Delivery in <37 weeks).

The proposed study will ask the participants to complete two different stress calculation scales, including Perceive stress scale, and pregnancy experience scale. This will evaluate the stress during the time participant was pregnant and how stressful did she find her pregnancy for herself.

Although the main outcome of this study is pre-term delivery, but these stress scales are incorporated as a part of study to enhance our knowledge about the degree of psychological and mental stress a physician suffers during her pregnancy compared to a non-physician pregnant female.

There are two goals attached with this proposed study survey. First, is to evaluate the association between employment as a resident and increased risk of pre-term delivery by comparing the work hours of residents with non-residents. And second is to determine psychological stress in pregnant female residents and comparing it with non-resident pregnant females who work less than 80 hours per week.

EXPOSURE OF INTEREST- PROLONG WORKING HOURS

The main exposure of interest of this study is the long hours of work during pregnancy (>80 hrs/week). As discussed in the above sections, long working hours during pregnancy are significantly associated with adverse pregnancy outcomes such as intrauterine growth restriction, preterm labor and preterm birt ^[1]. The longer work shift not only requires prolong periods of standing, but also disturbs the diet of the mother, and results in sleep deprivation, poor nutrition intake, high degree of mental stress and job strain that all together imparts negative effects on the pregnancy outcome ^[64,65]. When compared to female physicians, non-physician females have working hours less than 80 hours per week ^[20] and therefore it is important to compare and contrast the pregnancy outcomes of these two population groups.

OUTCOME OF INTEREST- PRE-TERM BIRTH

The outcome of the study will be the incidence of pre-term birth among pregnant physicians and their matched pregnant non-physician females. Pre-term birth can be defined as the birth of an infant at less than 37 weeks of gestation ^[14]. Birth of an infant due to pre-term labor or preterm premature rupture of membrane is called as spontaneous preterm birth ^[14]. Currently, about 12-13% of infants in the US are born pre-term, compared to 9.5% in 1981 ^[66]. There are several risk factors of preterm birth of the baby, including maternal (Pre-eclampsia, maternal smoking, antepartum hemorrhage, sever maternal stress) and fetal (multiple gestation) ^[66]. Preterm delivery of the baby is a leading cause of infant morbidity and mortality, and is responsible for about 75% of perinatal mortality and long term morbidity in the infant ^[66]. It is also a well-known cause of maternal postpartum depression ^[67].

Although previous literature has shown a significant rate of pre-term birth among pregnant female residents, but none of them used a large sample size covering physicians from multiple specialties. In addition to this, the data has been reported in the late 1980's^[1,39].

STUDY DESIGN, STUDY POPULATION AND SELECTION

This proposed study will be a retrospective cohort, which will use the sample size of total 998 females that will include 499 female residents and 499 women of the comparison group which includes the wives of male residents.

The study subjects: The main study subjects will be the female residents of the department of Internal Medicine, Emergency Medicine, General surgery, psychiatry, and Obstetrics and Gynecology, who will be compared with their matched comparison group.

Inclusion criteria for the cases will be: female physicians who had been pregnant during the residency years.

The matched comparison group will be the wives of male physicians. They are selected to avoid the huge differences in the socioeconomic status that might act as a confounder. Exclusion Criteria- Physician wives of male residents will be excluded from the study.

Selection of the participants: The study will be conducted in the form of survey questionnaire, which will be mailed to the physicians who have graduated from the residency years in the last 5 years. Selection of the cases and comparison group will be done randomly, and the names and addresses of the residents will be obtained from American Medical Association's Mater File. All the selected physicians will be mailed a questionnaire, along with psychiatric scales, a covering letter and a consent form. Male physicians will be required to hand over the questionnaire to their wives. Non-responding participants will be mailed another reminder letter after one month of non-response.

The questionnaire will cover the basic demographic information, occupation, smoking and alcohol use, parity, weight, height, year of last delivery, number of hours employed per week in first, second, and third trimester, the total number of pregnancy weeks and the outcome of the pregnancy and other related variables as mentioned below.

Continuous variables of interest: age, weight, height, weight gain in pregnancy.

Categorical variables: race, parity, smoking during pregnancy, hours employed per week, average hours of standing during work, night duties per week, average hours of sleep during pregnancy, pregnancy complications, and the birth weight of newborn, vaginal infections during pregnancy.

Additional scales to be used: The study will also use two scales in addition to the questionnaire. One will be the perceived stress scale (PSS) and the second will be the pregnancy experience scale (PES). The main purpose of using these scales is to have a better knowledge of mental stress among pregnant residents and compare that to non-resident females.

OVERCOMING THE LIMITATIONS OF PREVIOUS RESEARCH

A study on physician pregnancies and their outcomes is important for various reasons. First, physician pregnancies are considered high risk due to the increase physical and mental job stress and high demands of energy at work^[1]. In addition, a study on physician pregnancy taking wives of male residents as a comparison group will help in understanding the effect of environment on health and disease in the same socioeconomic background.

Moreover, the number of female residents has increased dramatically in the last decade, and pregnancies among female residents are becoming more common compared to the past. Also, the guidelines of ACGME have changed in the last couple of years, making it necessary to study the progress made, and to report current findings on pregnancy outcomes of female residents.

This present study will include a randomly selected large pool of residents from Internal Medicine, Emergency Medicine, OBGYN, Psychiatry, and General surgery, to minimize the selection bias. This retrospective cohort will take the wives of male residents as a comparison group in order to adjust for socioeconomic status, thus limiting the confounding in the data. The comparison group will also be randomly selected.

Unlike previous studies that were done in either community based-private hospitals or university hospitals, this study will select residents from the Master file of American Medical Association, thus reducing the chances of selection bias and increasing the generalizability and external validity of the reported data.

STATISTICAL ANALYSIS

Descriptive and Inferential statistical analysis will be carried out in this study. Results on the continuous measurements will be presented on Mean +/- SD (Min-Max) and results on Categorical measurements will be presented in Number (%). The significance will be assessed at 5% level of significance. The results of the stress scales will also be reported in Number (%).

The following statistical assumptions will be made:

- Dependent variables will be normally distributed, and
- Samples drawn from the selected population group will be randomly selected.

All the data will be reviewed for completeness of the record regarding the estimation and assessment of exposure, outcome, and covariates. The statistical software of SAS 9.3, will be used for the data analysis of such study design. Microsoft word and Microsoft Excel will be used to generate the graphs and tables. Descriptive statistics of exposure and covariate characteristics will be calculated and compared using the Chi-square analysis. Exposure risk ratio will be calculated using the Modified Poisson Regression model with 95% confidence intervals. The results will be adjusted for age, parity, height, weight gain, race or ethnicity by the use of multiple logistic regression methods. The adjusted Odds Ratios from the above logistic regression model that may also include any interaction, or potential confounders, will be reported.

SAMPLE SIZE CALCULATION AND ANTICIPATED RESULTS

The sample size needed to detect the Risk Ratio of 1.5, under the assumption of an incidence of pre-term delivery to be 10%, a power of 80%, α of 0.05, and correlation coefficient of 0.3, comparing one exposed to one non-exposed will be 1000 (500 female residents and 500 women in the comparison group). Also, the expected Relative risk is also expected to be statistically significant (RR+1.5) with 95% confidence interval using the Modified Poisson Regression model.

The significant association of pre-term birth with long working hours of pregnant residents will support the present literature and will report the most recent data from the last five years. In addition, the other study variables including number of sleep hours, stress during pregnancy and the weight of an infant will also provide an accurate picture of the current situation and will highlight the importance of having a fair maternal leave policy for female residents. The inclusion of large sample size and the random selection of the sample will increase the external validity and generalizability of the data. In Future, this study can help in revising the maternity leave policies for female residents, by either increasing the number of weeks of maternity leave, or let them take the vacation days from their future residency years to increase maternity leave, or by giving them a research elective month during their maternity leave, which they should be allowed to do from home, in order to avoid the compromise on their residency training ^[59].

STRENGTHS OF THE PROPOSED STUDY

The study will evaluate the pregnancy outcome among female residents who have completed their residency training in the last five years. The topic of occupational stress among female residents has been studied previously; however the data is from late 1980's to 1990's. This study will provide the recent data after the implementation of new ACGME guidelines since 2003. Also, the mental health of the pregnant residents will be compared with their non-resident comparison group using the PSS and PES scale. Several additional risk factors for premature labor and delivery such as excessive physical activity and vaginal infections will also be asked to avoid cofounding.

LIMITATIONS OF THE PROPOSED STUDY

There will be several limitations associated with this study. First, an issue of recall bias may be introduced in retrospective cohort study design. A bias may be reported in recall or reporting of the covariates such as smoking, alcohol use, and any pregnancy complication other than preterm birth. The study will be in the form of self-reporting survey, which can give rise to over-reporting of the exposures by the residents or the comparison group. Also, non-response bias and measurement error based on self-reports will also be additional limitations.

CONCLUSION

Long working hours among pregnant female residents and the association of an adverse pregnancy outcome is still an important issue. The topic has not been very well studied after the new resident work-hour guidelines were introduced. This review article provides an overview of the association of adverse pregnancy outcomes with the long working hours of female residents. The article also suggests a study design of a retrospective cohort study that will provide latest results on this topic. This may also help in devising new work-hour guidelines for pregnant female residents without any disturbance to their residency career.

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