

REVIEW Article

Pregnancy challenges and outcomes among female physicians

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ABSTRACT

Female physicians constitute an increasing proportion of the total physician workforce. Lengthy training often causes delays in family planning. When they feel ready and plan to have children, they might face demanding work hours, limited options for parental leave and child support, and potential stigmatization by peers and superiors. The impact of these factors on female physicians' fertility, pregnancy complications, professional growth, and perceptions of a career in medicine as a barrier to motherhood is not well-established. The goal of this study was to identify the main challenges and risk factors for pregnancy complications among U.S. female physicians.

Age, stress, adverse working conditions, occupational hazards, and insomnia were some of the main factors that can affect female physicians' fertility. A higher rate of infertility and older age at delivery were observed among female physicians working in surgical specialties. Being a physician is often associated with higher rates of infertility and pregnancy complications than the general population.

Although female physicians are increasing in number, they continue to encounter challenges in family planning and personal and professional life balance. More research is needed to assess policy gaps, stigma, stereotypes, and risk factors, especially among different specialties. It becomes essential to develop effective strategies to adequately address these concerns and to offer equal and accessible reproductive care for female physicians.

SUMMARY

1. *Introduction*
2. *Physician gender disparity in parenthood*
3. *What are the challenges that female physicians encounter when planning a family?*
4. *Are the female physician's pregnancies associated with higher risk for adverse pregnancy outcomes?*
5. *Pathophysiologic Mechanisms of Infertility and Pregnancy Adverse Outcomes among Female Physicians.*
6. *Discussion*
7. *Conclusions*

Abbreviations

United States (U.S.); adjusted Odds Ratio (aOR); confidence interval (CI); postpartum depression (PPD); hypothalamic–pituitary–adrenal axis (HPA); Corticotropin-releasing hormone (CRH); gonadotropin-releasing hormone (GnRH); pro-opiomelanocortin (POMC); Corticotropin-releasing hormone receptor 1 (CRH-R1); carcinoembryonic antigen-related cell adhesion molecule-1 (CEACAM1); 11 β -hydroxysteroid dehydrogenase type 2 (11 β -HSD 2); tumor necrosis factor (TNF); interleukin-6 (IL-6); C-reactive protein (CRP); Electronic Health Record (EHR); hypertensive disorders of pregnancy (HDP); Health Resources and Services Administration (HRSA); Department of Health and Human Services (HHS).

Keywords

Female physicians, infertility, pregnancy, pregnancy complications.

1. Introduction

The percentage of female physicians within the total physician workforce has been rising. From 2007 to 2023, the percentage of physicians who identified as female increased from 28.3% to 37.6%¹. Female physicians who plan to have children may face demanding work hours, limited options for parental leave and child support, and potential stigmatization by peers and superiors². In addition, family responsibilities, poor human resource policies, and gender inequalities that slow professional growth are contributing factors that may lead to female physicians viewing a career in medicine as a barrier to motherhood^{2,3}.

Female physicians have a long training path including medical school, residency training, and possibly fellowships. The average age at medical school graduation is 27.5 years, at completion of training (completion of medical school, residency, and/or fellowship) is 31.6 years, while the age at first pregnancy is 30.4 years⁴. However, increasing age negatively affects fertility. In female fetuses, oocyte count peaks at 20 weeks gestation. Oocyte numbers slowly decline from this point until 32 years old, at which point the decline in reserve becomes progressively faster⁵.

The incidence of infertility in the U.S. is estimated to be 9%–18% among the general population⁶ while 1 in 4 female physicians struggle with infertility⁴. Only 2% of female physicians had children before

completing medical school. During residency training, family physicians have been reported to have similar rates of childbirth to nonphysicians, while specialists had lower rates of childbirth until they began independent practice².

Pregnancies at older ages are associated with greater risks for complications during gestation and delivery⁷. Compared to 25- to 29-year-olds, females 35 years old and above had greater odds of preterm delivery, hypertension, severe preeclampsia, and superimposed preeclampsia. If 40 years old or greater at the time of delivery, risks increase for mild preeclampsia, poor fetal growth, and fetal distress⁸. Morbidity rates were 1.8 times higher in pregnant females 35 years old or above (127.9) compared with those at 20–24 years old (72.3)⁹. Between 2019 and 2021, the mortality rate in females aged 20 to 44 rose from 97.2 to 136.4 deaths per 100,000⁹.

The goal of our study is to identify the main factors for infertility and pregnancy complications among U.S. female physicians and areas with the greatest potential for improvement.

2. Physician gender disparity in parenthood

Among plastic surgeons, females were more likely than males to have no biological children (45.1% versus 23.1%). The findings included delayed childbirth due to demands of training (72.6% females versus 39.2% males) and were more likely to experience infertility (26.3% females versus 12.5% males). Among plastic surgeons who had no children, there were more females (20.1%) who responded they did not want to have children versus male plastic surgeons (1.8%)¹⁰. Among female oncologists, 1 in 3 reported experiencing infertility and 1 in 3 stated they experienced discrimination during pregnancy and/or for taking maternity leave¹¹.

3. What are the challenges that female physicians encounter when planning a family?

Additionally, Canadian female otolaryngologists and neck surgeons report facing challenges in family planning, ability to conceive, and breastfeeding¹².

There are several barriers related to fertility, family planning, and reproductive health among women physicians¹³. Female physicians appear to delay childbearing when compared to nonphysicians, and this phenomenon mostly occurs among specialists. Physicians seem to catch up to

nonphysicians by starting reproduction at older ages and thus may be prone to increased risk of adverse reproductive outcomes¹⁴.

Female physicians face several barriers related to fertility, family planning, and reproductive health. Lai et al. collected survey responses from 4533 female physicians. Respondents were older at first pregnancy and had higher rates of infertility evaluation and treatment, as well as higher rates of miscarriage and preterm birth than the general population. Only 8% of those surveyed received education on the risks of delaying pregnancy during training. Those who were educated were significantly less likely to experience miscarriage or seek infertility evaluation or treatment. Physicians in nonsurgical specialties were younger than surgeons at the time of their first pregnancy, had fewer preterm births and fetal growth problems, and had more children¹⁴.

In one report, 25.5% of physicians encountered fertility issues, 72.9% of whom used fertility drugs, followed in prevalence by 54.2% who used fertility tracking. Among the main factors physicians reported for delaying pregnancy were demands of training (72.9%) and long work hours (61.5%)¹³.

Several studies have been conducted to shed light on pregnancy struggles and complications among females working in healthcare. The infertility rate among American female surgeons was more than twice the rate of the general population¹⁵. Often pregnancies were delayed due to training (65.0%), or required fertility treatment (24.9%), and experienced increased pregnancy complications when compared with the female partners of their nonchildbearing colleagues. Working more than 12 hours per week in surgery during pregnancy was associated with higher risks of pregnancy complications¹⁵. Surgeons experienced pregnancy loss (42.0%), stillbirth (3.8%), musculoskeletal disorders (36.9%), nonelective cesarean delivery (25.5%), and postpartum depression (11.1%)¹⁵.

More than half of all female surgeons delayed childbearing until they finished their training and were practicing independently¹⁶. Pregnancy during surgical training is associated with negative perceptions from peers^{16,17}, pregnancy complications, and scheduling challenges¹⁷. However, in medical residency programs with female leadership, residents perceived a more supportive environment for having a pregnancy¹⁸. Out of 377 female physicians, 39.4% reported that their job prevented breastfeeding for the

desired length of time or had significant workplace limitations to breastfeeding (52.2%).

Huguet et al., collected 398 responses from female otolaryngologists; their mean age at first pregnancy was 32.3 years, and 30.4% of them were diagnosed with infertility. When asked what they would do differently in retrospect, most women with infertility (65.0%) responded they would have attempted conception earlier; 41 (41.0%) would have used cryopreservation to extend fertility; and 14 (14.0%) would have gone into a different specialty¹⁹.

Similar findings were reported concerning female urologists. They also gave birth at older ages, had greater fertility issues, and used assisted reproductive technology. In addition, they reported a higher level of at least one complication during pregnancy when compared to U.S. females overall^{20,21}. Female orthopedic surgeons had an increased risk of pregnancy complications, particularly preterm delivery, compared with the general U.S. population, especially among surgeons working more than sixty hours per week during pregnancy²².

For female physicians in procedural-based medical specialties, longer training and more intensive physical demands are required. Female physicians working in procedural fields perceived more challenges and were more likely to delay pregnancy when compared to female physicians non-proceduralists. However, rates of missed work due to pregnancy-related complications, reproductive assistance, and cesarean delivery were similar²³. Those in procedural fields had greater rates of burnout and attrition from medicine, which the study attributed to difficulty balancing personal and professional demands²³. A 2018 survey of the childbearing experiences during residency of anesthesiologists who completed a U.S. residency in 2000 or later found similar rates of pregnancy complications as the general U.S. population²⁴. However, 65.7% of residents were discouraged from taking additional maternity leave and 51.6% of residents felt discouraged from being pregnant or having children, with rates not significantly changing over time²⁴.

Female surgeons and physicians experience significantly greater infertility rates and pregnancy complications than other professional females. Delayed childbearing was observed in 65.0% of surgeons, 66.1% of non-surgeon physicians, and 57.5% of lawyers and those with other doctorates ($p < 0.001$)²⁵. Assisted reproductive technology was

utilized by 24.9% of surgeons, 43.0% of non-surgeon physicians, and 21.7% of lawyers and those with other doctorates ($p < 0.001$)²⁵.

4. Are the female physician's pregnancies associated with higher risk for adverse pregnancy outcomes?

Associations between physicians and pregnancy complications have been studied for over 30 years. In a 1990 study including three-year residencies (i.e. pediatrics, internal medicine, and family medicine), the rates of preterm delivery for women in postgraduate years 1, 2, and 3 were 8.4%, 3.2%, and 5.6%, respectively ($p = 0.46$)²⁶. Corresponding rates of infants with small for gestational age at delivery were 4.2%, 5.7%, and 6.1% ($p = 0.53$)²⁶. Among residents, almost twice the rate of pre-eclampsia or eclampsia was observed, and this association did not change after adjustment for parity. Placental abruption was less likely to occur among residents ($p = 0.054$)²⁶. In these specialties, as training progresses physicians have fewer working hours and nights on-call which provides evidence against a strong effect of workload on pregnancy outcome, as no significant differences were found between years²⁶. In the years since this study was performed, the structure of residency has changed, with work hours being restricted to 80 hours per week for residents.

Takeuchi et al. more recently studied the effect of long working hours and pregnancy complications among female physicians in Japan²⁷. Out of the 939 subjects, 42% reported at least one complication during their first pregnancy. Threatened abortion (15%) and preterm birth (12%) were the most frequent complications, and (3.8%) of participants experienced both threatened abortion and preterm birth²⁷. Family physicians, when compared to nonsurgical specialists (aOR, 1.12; 95% CI, 0.82-1.53) or surgical specialists (aOR, 1.43; 95% CI, 0.74-2.76), were not at increased risk of severe maternal morbidity²⁸. Similar findings were observed for severe neonatal morbidity (nonsurgical specialists: aOR, 0.98; 95% CI, 0.80-1.19; surgical specialists: aOR, 1.08; 95% CI, 0.68-1.71)²⁸. Findings showed that female physicians overall may be at a slightly higher risk of severe maternal morbidity and delayed childbearing when compared to nonphysicians²⁸. Female plastic surgeons experienced seven times higher odds of having difficulty conceiving or carrying a pregnancy,

twice the rate of miscarriage, and higher rates of obstetric complications and congenital malformations (47% vs. 20%, and 8% vs. 4%, respectively) when compared to the general U.S. population.²⁹

Postpartum depression (PPD) among medical residents was another pregnancy complication reported. Female medical residents reported feeling PPD symptoms (42%) at more than four times the rate of PPD in the general population (11%). However, only 12% of them sought treatment or were diagnosed with PPD. Male residents did not report an increased rate of depressive symptoms; however, 19% of respondents believed their partner's symptoms were consistent with PPD³⁰.

5. Pathophysiologic Mechanisms of Infertility and Pregnancy Adverse Outcomes among Female Physicians

Age. Increasing age is associated with decline of female fertility. Over time there are several factors that might affect fertility, such as decline in egg quality, reduced ovarian reserve, and increased frequency of health conditions⁷.

Stress. The stress system relates to all the major endocrine axes, including the reproductive axis. In males and females, the reproductive system can be inhibited by various components of the hypothalamic-pituitary-adrenal axis (HPA), at all levels. Corticotropin-releasing hormone (CRH) suppresses the gonadotropin-releasing hormone (GnRH) neurons directly and indirectly via enhancing β -endorphin secretion by the arcuate pro-opiomelanocortin (POMC) neurons. Corticotropin-releasing hormone receptor 1 (CRH-R1) partially mediates the effects of restraint acute stress on the reproductive axis, whilst antalarmin (a selective CRH-R1 antagonist) can stop these effects. In addition, glucocorticoids serve as inhibitors of GnRH neurons, pituitary gonadotrophs, and the gonads, and cause resistance to sex hormones on target organs and tissues. On the hypothalamic level, there is observed inhibition of the pulsatile GnRH secretion and concomitantly steroidogenesis is directly inhibited at the level of ovaries and testes. Specific pro-inflammatory circulating cytokines can also remarkably suppress the reproductive function at multiple levels, providing a link between reproductive dysfunction and inflammatory stress³¹.

The inhibitory effect at the hypothalamic level can cause functional hypothalamic amenorrhea especially in situations of eating disorders, chronic excessive exercise, and prolonged or chronic stress³². In women exposed to high psychosocial stress, the ovarian CRH is also one of the potential mechanisms implicated in the premature ovarian failure³³. CRH can also affect embryo implantation and pregnancy maintenance by killing activated T-cells and regulating the expression of carcinoembryonic antigen-related cell adhesion molecule-1 (CEACAM1)³⁴.

Prenatal maternal stress can also reduce the activity of placental 11 β -hydroxysteroid dehydrogenase type 2 (11 β -HSD 2), thus allowing high circulating levels of maternal glucocorticoids to enter the fetal circulation. As a result, it can cause early and long-term developmental effects resulting in part from altered maternal and/or fetal glucocorticoid exposure³⁵. Maternal stress, depression, and anxiety in pregnancy can affect “fetal programming” in a child. Animal models used for research indicate that maternal distress negatively influences long-term learning, motor development, and behavior in offspring³⁶.

Stress has the potential to impair fertility during critical periods involving regular menstruation, successful ovulation, implantation, and placental growth and development³⁷. Among female physicians 26-37 weeks pregnant, urinary catecholamines increased by 58% ($p < 0.03$) during work periods compared with non-work periods³⁸. An increase of 64% ($p < 0.025$) occurred in the working non-physician control group of similar gestational age³⁸. Catecholamine levels can decrease uterine blood flow and tend to reach higher levels during physical stress, such as standing, and mental stress, such as difficult problem-solving.

Occupational hazards and working conditions.

Adverse pregnancy outcomes among healthcare workers have been linked to poor working conditions including long working hours, prolonged standing, lifting heavy objects, and psychological stress. Also, poor ergonomic practices (factors likely to affect interactions between an individual and their working environment) often increase existing discomfort, which can cause increased rates of work absenteeism, sick leave, and a lack of motivation among pregnant healthcare workers³⁹.

Overtime work among female nurses was associated with an increased risk of threatened

abortion, while handling disinfectant was associated with an increased risk of threatened abortion and spontaneous abortion. In addition, nurses handling anti-cancer drugs were found to have an almost twofold increased risk of premature birth⁴⁰.

Several occupational hazards, such as radiation exposure (at >100 millirems), infectious bioagents, heavy lifting, and prolonged working hours (>12 hours per shift), can negatively impact a developing fetus⁴¹. Sources of X-rays and gamma rays can cause birth defects, low birth weights, infertility, miscarriage, and other developmental disorders⁴². In addition, sharps injury, anesthetic gases, radiation, surgical smoke, working conditions, and intraoperative use of toxic agents can affect physicians working in the operating room. Studies have shown that surgeons have higher rates of spontaneous abortion, preterm delivery, growth restriction, congenital abnormalities, infertility, and pregnancy complications when compared with the general population⁴³.

Pregnant staff working in the orthopedic operating room may be at risk of occupational exposure to several occupational hazards thought to be a threat to fetal development, such as anesthetic gases, methylmethacrylate, blood-borne pathogens, physical stress, and radiation⁴⁴. However, very few studies have been conducted on the physician population regarding exposure to anesthetic gases⁴⁵. Additionally, it is not clear whether modern anesthetic gas scavenging systems are sufficient to prevent exposure to operating room personnel⁴⁶, and particularly, anesthesiologists. When comparing pregnancy complications and losses between attending anesthesiologists and obstetricians, 65.1% of anesthesiologists and 65.5% of obstetricians reported at least one pregnancy complication, and 36% and 24% reported at least one pregnancy loss, respectively⁴⁷. There was no significant difference between groups in terms of overall complication rate or types of pregnancy complication, although rates of complications and losses are higher than those of both the general population and other specialties in previous reports⁴⁷. Pediatric anesthesia more often requires induction with inhaled gases as compared to adult anesthesia, exposing pediatric anesthesiologists to higher levels of anesthetic gases. Gauger et al compared pregnancy complications among pediatric anesthesiologists to those among adult anesthesiologists and found a significantly higher prevalence of spontaneous abortion in pediatric

anesthesiologists. There was no significant difference observed in any other pregnancy complications between the two groups⁴⁸.

Insomnia. Insomnia may co-occur with, or result in, HPA activation, thereby leading to infertility. Patients with chronic insomnia were found to have elevated stress hormone responses when compared to people who have good sleep. Sleep dysregulation may alter successful conception through the suppression or augmentation of reproductive hormones and may affect conception via compromised immunity (sleep loss is associated with increased tumor necrosis factor (TNF) and interleukin-6 (IL-6), as well as elevated C-reactive protein (CRP) is found in young women with poor sleep). There is some evidence that links circadian influence with shift work and infertility³⁷.

Other factors. Some other common factors that affect fertility in the general population are smoking, excessive alcohol use, overweight/obesity or underweight, extreme weight gain or loss, and excessive physical or emotional stress⁷.

6. Discussion

Evidence-based research shows that female physicians may be more likely than their male colleagues to adhere to clinical guidelines, provide more psychosocial counseling to their patients, and provide preventive care more often, including cancer screening services. They tend to use more patient-centered communication and are likely to spend more time with their patients than male physicians. They more often adopt a partnership-building style with patients⁴⁹. Training necessary to practice independently is long. The average age at completion of training is 31.6 years, and physicians tend to have their first pregnancy around 30.4 years old⁴. Older age affects female fertility with a progressive decline in egg quality, and reduced ovarian reserve, as well as increased incidence of other health conditions that also can affect fertility⁷. The causes of infertility and the pregnancy outcomes among female physicians remain understudied and unaddressed. System-level interventions should be considered to support female physicians who wish to have children at all career stages².

The share of physicians in the U.S. that would recommend medicine as a career to young people

from 2014 to 2021 declined from 59% to 46%⁵⁰. Inadequate support in the workplace environment can lead to an unbalanced equilibrium between professional and personal life and also affect family responsibilities. In addition, stereotyping and discrimination increase stress levels, lower work productivity, and lower life satisfaction. Low life satisfaction can negatively affect both workers' personal lives, as well as their professional productivity and work quality. It is essential to consider reducing long working hours, offering flexible timing and part-time work options that might contribute to increasing the motivation of females working in the healthcare workplace³.

Between 2019 and 2022 there was observed an 8.3-minute increase per year in the already existing gap between the time men and women physicians spend on the Electronic Health Record (EHR) for every eight hours of scheduled clinic time. Male physicians spent 5.3 hours interacting with the EHR while women physicians spent an average of 6.4 hours in the EHR for every eight hours of patient scheduled time⁵¹. This disparity in work outside of work is concerning given its association with physician burnout. A root cause analysis must be done to explore the causes behind these differences and develop solutions to address them, considering the higher rates of burnout among female physicians. Among female physicians who had young children and reported support from their colleagues, spouses, or significant others at work and at home, the odds of burnout decreased by 40%⁵². Having a pregnancy during medical residency can be challenging. Pregnant residents are more likely to be placed on bed rest for high-risk pregnancies than the general population²⁶. A survey study during the years 2012-2013, collected data from a sample of 600 female physicians. A substantial proportion of them have faced infertility or have regrets about family planning and career decision-making⁴. Having a medical career and combining it with motherhood continues to be challenging and deserves further investigation and targeted support.

The most commonly reported concerns during pregnancy among health professionals are neck pain, nausea, vomiting, back pain, and pelvic girdle pain. Working night shifts increases the risk for having pregnancy complications such as miscarriage, threatened abortion, premature labor, and hypertensive disorders of pregnancy (HDP), and the risk increases with the number and length of shifts⁵³.

For females working in healthcare, inconsistent maternity protection laws, lack of paid parental leave, financial losses, and career opportunities during pregnancy, can pose additional challenges. In addition, interpersonal relationships and difficulties in adapting to work during pregnancy and postnatally often add to the already substantial time and effort involved in breastfeeding. Pregnancy and gender discrimination in the workplace should be recognized. It is important to provide specific maternity protection rules in occupational health and safety legislation at the national level⁵³. When having a family, female physicians are more likely than male physicians to work part-time or discontinue working completely⁵⁴. Inconsistent and unclear maternity protection policies, such as paid parental leave, can financially penalize families, reduce career opportunities and productivity, and make breastfeeding difficult⁵⁵. There is a lack of access to adequate insurance coverage for this higher risk group⁵⁶. Evidence-based research shows that up to 25% of female physicians are seeking assisted reproductive technology⁵⁶. Currently, 1 cycle of assisted reproductive technology, or egg retrieval, is estimated to cost approximately \$19,000, with many patients needing multiple cycles⁵⁶. Only a few institutions offer coverage for those seeking oocyte or embryo cryopreservation for elective fertility preservation⁵⁶. Cryopreservation is another emerging request being considered by female physicians. Females (46.0%) are more likely than males (23.7%) to state that employer-sponsored covered planned oocyte cryopreservation would influence their residency ranking.⁵⁷ Less is known to what extent employer-sponsored covered cryopreservation would determine medical career decision-making⁵⁷.

These findings suggest that different strategies may be needed to improve the work lives of female physicians.

7. Conclusions

Studies indicate that family planning at an older age, long working hours, physical and psychological stress, occupational hazards and lack of full support from employers and colleagues are some of the main factors related to increased risk for adverse events during pregnancy among female physicians. Childbearing age coincides with peak medical training, causing a career in medicine to be viewed as

barrier to motherhood. Infertility treatments are often required and only few institutions offer coverage.

More research is required to better understand all the factors related to infertility and pregnancy complications among female physicians. With increasing numbers of female physicians in the healthcare industry, it has become essential to develop effective strategies to adequately address these concerns and to offer equal and accessible reproductive care for female physicians. This should lead to consistent, research-informed policies pertaining to fertility, pregnancy and parenting for physicians and healthcare professionals.

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Conflict of Interest

The authors declare no conflicts of interest.

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