

ORIGINAL RESEARCH

Physician Wellness

IMPACT survey: Impaired fecundity in Physicians and Association with Clinical Time

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Abstract

Objective: Studies suggest female physicians experience higher rates of infertility than the general population. The overall objective of this study was to determine the rate of impaired fecundity in a sample of female emergency physicians and compare it to the Centers for Disease Control and Prevention (CDC) National Survey of Family Growth (NSFG) data. Impaired fecundity is defined as physical difficulty in getting pregnant or carrying a pregnancy to live birth.

Methods: We performed a cross-sectional survey of female emergency physicians to determine the rate of impaired fecundity. Survey questions were adapted from the NSFG to allow comparison to the general population. Statistical comparisons were made using contingency tables (with chi-square and tau-c assessments), 1-sample *t* tests, and independent samples *t* tests, as appropriate.

Results: A total of 2072 women completed the survey with a mean (SD) current age of 38.9 (7.2) years. Data were analyzed for women of childbearing years (15–44 years old as defined by the CDC; *n* = 1705 [82% total responses]). The rate of impaired fecundity in emergency physicians was 24.9% as compared to the NSFG cohort (12.1%; *P* < 0.001). Female emergency physicians with impaired fecundity reported working 9.8 overall more clinical hours (95% CI 2.5–17) and 4.5 more night hours (95% CI 0.8–8.2) than those with normal fecundity.

Conclusion: Female emergency physicians have increased rates of impaired fecundity when compared with a general population cohort. Clinical workload and night shifts are greater in female emergency physicians with impaired fecundity. Research is needed to elucidate work-related impaired fecundity risk factors.

KEYWORDS

gender research, infertility, physician wellness, reproductive health

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1 | INTRODUCTION

1.1 | Background

The number of women in medicine has grown significantly. A 2017 Association of American Medical Colleges (AAMC) survey of accredited medical schools revealed that over half of matriculants were women.¹ In emergency medicine women now comprise 35% of applicants to emergency medicine residency programs² and 28% of the active workforce.³ Women who obtain advanced degrees have an increased risk of involuntary childlessness related to delayed childbearing.⁴ In a study including all specialties, female physicians were diagnosed with infertility at a rate over twice the national average (24.1% vs 10.9%).⁵ Female physicians in procedure-oriented specialties may experience a higher rate of infertility than the general population.^{4–7}

1.2 | Importance

Rates of infertility in women practicing emergency medicine are unknown. This knowledge gap limits the ability of advisors and medical specialty boards to support female physicians planning a career in emergency medicine. Female doctors who face difficulties in the field of reproduction are potentially more likely to experience burnout.⁸ Concern about pregnancy and childbearing may affect medical students' decisions on careers. Healthcare leadership needs accurate data to be able to counsel female medical students, residents, and faculty appropriately on potential infertility risks.

1.3 | Goals of this investigation

This study examines the rate of impaired fecundity in a sample of female emergency physicians and compares this rate to a national database (2011–2015 Centers for Disease Control and Prevention's [CDC] National Survey of Family Growth [NSFG]).⁹ *Impaired fecundity* is defined as physical difficulty in either getting pregnant or carrying a pregnancy to live birth.¹⁰ We also aimed to describe some emergency medicine work-related characteristics that may affect impaired fecundity. We hypothesized that women in emergency medicine would have higher rates of impaired fecundity when compared to the general population. To our knowledge, this is the first study to evaluate impaired fecundity in emergency physicians and is the largest survey of practicing women physicians related to reproductive health.

2 | METHODS

2.1 | Study design and participants

We performed a cross-sectional survey of women in emergency medicine to determine the rate of impaired fecundity and compared

The Bottom Line

In this cross-sectional survey of 1705 female emergency physicians, impaired fecundity was found in 24.9% of respondents compared to a national cohort sample (12.1%; $P < 0.001$).

it to the national 2011–2015 CDC NSFG database.⁹ Study design and reporting follows best practice recommendations as outlined by Mello et al¹¹ and involved survey study methodologists (TLJ, MJS). Data were collected from May 9, 2019, through August 10, 2019. This study was reviewed and found to be exempt by the University of Florida Institutional Review Board (IRB).

2.2 | Survey development

We used several approaches to develop the survey items. First, we identified factors related to infertility and impaired fecundity through a literature review. Second, we identified relevant questions from existing surveys focusing on physicians and fertility,^{4–7} including the NSFG,⁹ which collects information on family life, marriage and divorce, pregnancy, infertility, use of contraception, and men's and women's health. Finally, we identified additional occupational factors relevant to emergency physicians, including but not limited to work schedule (eg, clinical hours worked, nonclinical hours worked, night shift hours worked) and type of practice. When possible, questions used in the survey used the same language as the NSFG survey; this permitted direct comparison.

After the initial draft survey was completed, we took the following steps to provide validity evidence for the survey questions and design. First, subject matter experts in reproductive medicine reviewed the survey and provided input. Second, we pilot tested survey items for readability and clarity. Specifically, a pool ($n = 10$) of individuals representing the target subjects (women in emergency medicine) completed the survey and provided feedback regarding the survey prior to field implementation. Third, we conducted cognitive interviews using “think aloud” techniques to determine the extent to which the survey items represented the areas of interest of the investigators.^{11,12} Finally, questions were refined and reevaluated to establish content validity of survey items (Supplemental File 1).

2.3 | Survey implementation and data collection

All surveys were implemented using the University of Florida's Research Electronic Data Capture (REDCap) program.¹³ We utilized electronic mailing lists from three female-oriented emergency medicine professional organizations (Table 1) to distribute the survey. To increase the number of responses from women practicing in

TABLE 1 Survey distribution plan

Organization	Membership	Scope (local, regional, national)
FemInEM: Females Working in Emergency Medicine	4300	An open access resource where women discuss issues pertinent to women working in emergency medicine
AWAEM: Academy for Women in Academic Emergency Medicine	247	Established as an academy within the Society of Academic Emergency Medicine to promote the recruitment, retention, advancement, and leadership of women in academic emergency medicine
AAWEP: American Association of Women Emergency Physicians	1006	Provides a broad-based network of support, established as a section within the American College of Emergency Physicians to promote leadership skills for women in emergency physicians
Social Media Outlet (Facebook EM Docs) Closed Group https://www.facebook.com/groups/132952066891217/	~20,000 (includes both men and women)	A closed social media group on Facebook for emergency physicians to “share challenges and joys of emergency medicine”

non-academic settings, a link was posted on a closed group social media outlet for emergency physicians (<https://www.facebook.com/groups/132952066891217/>). IRB informed consent was contained on the first page of the survey. The survey link was sent twice to each electronic mailing list to improve response rates and reduce error from non-response. All responses were anonymous. Participants were instructed not to complete the survey if they had done so before; however, there was no formal mechanism to prevent duplicate responses.

2.4 | Outcomes

The primary outcome was impaired fecundity defined as physical difficulty in either getting pregnant or carrying a pregnancy to live birth.¹⁰ We used impaired fecundity as our primary outcome because it is more inclusive than the formal definition for infertility, which excludes women with multiple miscarriages preventing them from having a child. Our determination of impaired fecundity included difficulty in getting pregnant or miscarriage of first pregnancy. Secondary outcomes selected a priori included clinical and non-clinical hours worked and night shift hours worked. Survey items contained questions related to (1) reproductive health, (2) use of assisted reproductive technology, and (3) perceptions of work, family, and children.

2.5 | Analysis

According to the AAMC there were 11,658 active female emergency physicians in 2017—given a 99% confidence level and a 5% margin of error, the required representative sample would be 630.³ We defined completed surveys as those with responses to the questions related to respondent age, practice of emergency medicine, and number of pregnancies (see Supplemental File). Individuals were included if they had practiced emergency medicine in the past. The CDC defines “childbearing years” as ages 15–44; therefore, we included all subjects aged 44 and younger in analyses comparing emergency physicians to the NSFG cohort. Data were summarized using appropriate descriptive statis-

tics, for example, mean and median for continuous variables, percentages and frequencies for categorical variables. Statistical comparisons were made using contingency tables (with chi-square and tau-c assessments), 1-sample *t* tests, and independent samples *t* tests, as appropriate. All statistical tests were computed with IBM SPSS Statistics (version 26; Armonk, NY, USA).

3 | RESULTS

3.1 | Characteristics of study subjects

A total of 2067 female emergency physicians completed the survey with a mean (SD) current age of 38.9 (7) years. As with the NSFG survey, age classification was assigned based on the respondents' age at the time of survey completion. Data were analyzed for women ages 18–44, *n* = 1705 (82% total respondents) based upon the CDC definition of childbearing years (15–44 years old). One of the survey dissemination mechanisms was a closed social media site with varied membership; therefore, a true response rate cannot be determined. Respondents represented academic (941 [56.4%]) and non-academic (674 [40.4%]) physicians. Demographic data are provided in Table 2.

3.2 | Main results

The rate of impaired fecundity in female emergency physicians was 24.9% (425/1703) as compared with the general population reported in the NSFG 12.1% [$t(1704) = 12.8, P < 0.001$]. Because age is a strong predictor of impaired fecundity, we examined impaired fecundity by age group cohorts and compared female emergency physicians to similar age-based cohorts reported by the NSFG (Table 3). Impaired fecundity rates in the 35–39 and 40–44 year-old respondent age groups were 28.1% and 33.7%, respectively. This represents an impaired fecundity rate difference of 12.9% ($t[725] = 7.59, P < 0.001$) in the 35–39 year old cohort and 17.5% ($t[391] = 7.29, P < 0.001$) in the 40–44 year-old cohort. No differences were seen in the younger age group cohorts. For all respondents, the mean age when respondents

TABLE 2 Characteristics of survey respondents in the 18–44 year old age group

Characteristic	Respondents ages 18–44 ^a (n = 1705)
Age, year; mean (confidence interval)	36.24 (36.05–36.43)
Race, n (%)	
American Indian or Alaskan Native	8 (0.5)
Black or African American	66 (3.9)
Native Hawaiian or Other Pacific Islander	1 (0.1)
Asian	170 (10.1)
White	1325 (78.5)
Other	49 (2.9)
Did not answer	86 (5.0)
Ethnicity n (%)	
Hispanic or Latino	91 (5.3)
Not Hispanic or Latino	1485 (87.1)
Other/Not sure	7 (0.5)
Did not answer	122 (7.2)
Clinical setting, n (%)	
Academic	941 (55.1)
Non-academic	674 (40.0)
Other	52 (3.0)
Did not answer	38 (2.2)
Current training level n (%)	
Board-certified/eligible ^b	1393 (81.7)
Current fellow	31 (1.8)
Current resident	179 (10.5)
Other	16 (1.0)
Did not answer	86 (5.0)

^aWe show data for ages 18–44 to allow comparison with the CDC NSFG.

^bNot currently in fellowship training program.

met the definition of impaired fecundity was 32.6 (4.7), suggesting that initial impaired fecundity may occur at a younger age than what is reflected in our age-based cohort analyses. Additionally, use of assisted reproductive technology (263/1705 [15.4%]) in female emergency physicians was 3% higher overall than what is reported by the CDC¹⁴ (12.0% [0.5]; 95% CI [0.02–0.05]).

We evaluated work schedule risk factors that are thought to affect reproductive health.¹⁵ We found differences in work-related characteristics between in female emergency physicians with and without impaired fecundity (Table 4). Emergency medicine women with impaired fecundity worked 9.8 more overall clinical hours per month ($P = 0.013$; 95% CI [2.5–17]) and 4.5 more night shift hours per month than those with normal fecundity ($P = 0.017$; 95% CI [0.8–8.2]). No significant difference was noted for non-clinical hours worked ($P = 0.400$; 95% CI [–2.4–6.1]).

Participants also responded to several questions related to their opinions regarding childbearing and their career (Table 5). Overall,

TABLE 3 Comparison of impaired fecundity in the sample versus National NSFG Survey

	Emergency physician respondents % (No.)	NSFG Survey 2011–2015 ^a (%) (SE)	% Difference (emergency medicine–NSFG)
Total 15–44 years	24.9% (424/1705)	12.1% (0.41)	12.8%*
15–29 years	10.0% (8/81)	9.0% (0.57)	0.9%
30–34 years	15.8% (80/506)	14.0% (1.06)	1.8%
35–39 years	28.1% (204/726)	15.2% (1.36)	12.9%*
40–44 years	33.7% (132/392)	16.2% (1.24)	17.5%*

NSFG, National Survey of Family Growth.

^aSource: National Survey of Family Growth, Key Statistics: https://www.cdc.gov/nchs/nsfg/key_statistics/i.htm#impaired. N for interviews is 11,300; however, the NSFG is not based upon simple random sampling but uses a probability-based complex sample design that is meant to yield results representative of the US population. The NSFG sampled some populations at higher rates than others and adjusted sampling weights as appropriate. As a result, each respondent represents a different number of people in the United States. Thus, ratios and sample number would be inaccurate and are not provided. (https://www.cdc.gov/nchs/nsfg/nsfg_2015_2017_puf.htm).

* $P < 0.001$. One-sample t tests showed that significant differences exist between emergency physicians in the 35- to 39-year-old age group, $t(725) = 7.59$, $P < 0.001$ and the NSFG national sample; emergency physicians in the 40- to 44-year-old age group, $t(391) = 7.29$, $P < 0.001$ and the NSFG national sample; and, for the overall sample of emergency physicians age 44 and under, $t(1704) = 12.8$, $P < 0.001$.

respondents felt that having children was important to them. They noted that their career had a great deal of influence on childbearing, and childbearing had a great deal of influence on their career. There was greater variance in responses to questions related to how childbearing influenced career decisions.

4 | LIMITATIONS

Our study has several limitations. Our sampling methodology and inability to determine a true response rate introduces nonresponse bias. We identified participants through their membership in female-oriented professional organizations and one social media outlet specific to emergency physicians. The social media-based distribution of the survey was necessary to address issues of generalizability and help recruit non-academic physician subjects. However, it prohibited the ability to provide a true response rate. The anonymous nature of the survey also makes it possible that 1 individual could respond to the survey more than once. The investigators included warnings in emails to prevent this, but there is no definitive way to prevent multiple submissions from a single participant. We acknowledge the possibility of selection bias, as women with impaired fecundity could be more motivated to complete the survey, thus resulting in an inflated rate of impaired fecundity and presenting an additional limitation to the study.

Survey items require recall of past events, which could introduce recall bias into responses. It is somewhat unlikely that physicians would misremember birth dates or use of assisted reproductive technology;

TABLE 4 Work schedule in emergency physicians with and without impaired fecundity^a

Clinical hours	Overall	Normal fecundity ^a	Impaired fecundity ^b	Difference (95% confidence interval)
Clinical hours worked per month, ^c mean (SD)	87.1 (65.3)	84.7 (63.2)	94.4 (70.7)	9.8* (2.5–17)
Non-clinical hours worked per month, ^d mean (SD)	26.0 (37.7)	26.4 (38.2)	24.6 (35.9)	1.8 (-2.4–6.1)
Night shift hours worked per month, ^e mean (SD)	31.0 (32.6)	29.9 (31.5)	34.3 (35.6)	4.5* (0.8–8.2)

^aWork hours determined at the time of first pregnancy.

^bWork hours determined at the time first meeting definition of impaired fecundity.

^cRespondents $N_{(\text{total})} = 1633$; $N_{(\text{normal fecundity})} = 1220$; $N_{(\text{impaired fecundity})} = 413$.

^dRespondents $N_{(\text{total})} = 1600$; $N_{(\text{normal fecundity})} = 1200$; $N_{(\text{impaired fecundity})} = 400$.

^eRespondents $N_{(\text{total})} = 1595$; $N_{(\text{normal fecundity})} = 1197$; $N_{(\text{impaired fecundity})} = 398$.

* $P < 0.05$.

TABLE 5 Survey results regarding perceptions of work, family, and children

Question and anchors	Median score (IQR)
Having or having had children is important to me feeling complete as a person. ^a 1—Strongly disagree 3—Neutral 5—Strongly agree	5 (3–5)
It is/was important for me to have children. ^b 1—Strongly disagree 3—Neutral 5—Strongly agree	5 (4–5)
How much would you say your career has influenced your childbearing decisions? ^c 1—Not at all 3—Somewhat 5—A great deal	4 (3–5)
How much would you say childbearing has influenced your career decisions? ^d 1—Not at all 3—Somewhat 5—A great deal	4 (2–5)

IQR, interquartile range.

^a1559/1705 respondents (91%).

^b1570/1705 respondents (92%).

^c1571/1705 respondents (92%).

^d1559/1705 respondents (92%).

however, poor recall could impact memory of dates related to prolonged unprotected sex without pregnancy as well as work schedule details at the time of impaired fecundity. Our approach is consistent with the methodology used in the NSFG survey, which also relies on participants' recall, but recall bias remains a potential threat to validity of results.

We limited our assessment of impaired fecundity to first pregnancy. This was done because related questions for each pregnancy lengthened the survey considerably and we were concerned that feasibility would be an issue. However, we realize that this could result in underrepresentation of impaired fecundity among participants and thus presents a limitation to the study.

5 | DISCUSSION

This survey is the first national cross-sectional survey of reproductive health and impaired fecundity that targets female emergency physicians. Our study compared female emergency physicians with a national cohort of women surveyed through the NSFG. We found a higher rate of impaired fecundity when comparing female emergency physicians and the general population. This is similar to what has been reported in other research⁵ and provides additional evidence supporting the conclusion that impaired fecundity is a potential health issue for female physicians.

To determine if the higher rate of impaired fecundity in emergency physicians was because of delayed childbirth, we performed a subanalysis of respondents based on age categories used in the NSFG analyses. We found no difference in impaired fecundity when comparing 25–29 and 30–34 year-olds with similar cohorts in the general population. However, analysis of age groups 35–39 and 40–44 demonstrate significant increases in impaired fecundity when compared with similar age cohorts in the NSFG general population. This suggests a risk of delaying childbirth for female emergency physicians that is above and beyond baseline risks associated with advanced age and reproductive capacity. Additionally, we propose that the occupational factor(s) responsible for these findings are possibly (1) time-dependent, with risk correlating to increased exposure, or (2) variable, with effect dependent upon age.

Several potential occupational factors relevant to emergency physicians may have a negative impact on fecundity and reproductive health more generally. We found that when compared to women without impaired fecundity, women with impaired fecundity report working 11% more total clinical hours per month and 13% more night clinical hours. In other studies, irregular, rotating shift hours led to poor early reproductive outcomes and impaired fecundity, with the greatest negative impact seen in women working night shifts.^{16–18} Although the causal mechanism is unknown, evidence suggests that rotating shift work and night work results in changes in hormonal concentrations due to changes in circadian rhythm as well as decreases in oocyte maturation.^{19–24} This would suggest that minimizing shift variation could be one way to minimize the impact of shiftwork on female fecundity. Although evidence linking shift work and reproductive health is mounting, definitions of outcome variability, small study size, and

observational study design limit the strength of conclusions that can be drawn. It is therefore difficult to support occupational health recommendations at this time; however, it will be important to carefully separate issues related to shift variability from night shift work.²⁵

Infertility has a significant impact on physical and emotional wellness during and following childbearing years.²⁶ Considering the current national focus on wellness and female physician retention, this research fills a critical gap. Concern about pregnancy and childbearing can affect medical students' decisions on careers. Studies have shown that when considering a surgical specialty, female medical students were more worried about maternity leave policies, child care, and family flexibility than were male students.²⁷ Healthcare leadership needs accurate data to be able to counsel female medical students, residents, and faculty appropriately on potential infertility risks. Educating female physicians regarding the challenges of childbearing and fertility issues early in their career may encourage family planning earlier in their training, rather than delaying childbearing for career goals. Studies suggest that residents may not fully understand the limitations of assisted reproductive technology and often overestimate success rates.²⁸ Providing accurate information about risk and encouraging early evaluation of any reproductive challenges may be important.

In addition to improving counseling for females in training, this survey begins to provide awareness of the need for reproductive health and wellness policies during training and early practice to enable improved family planning. Female doctors who face difficulties in the field of reproduction are potentially less successful in coping with burnout.⁸ The majority of respondents noted that it was important for them to have children. Importantly, respondents noted that childbearing influenced career decisions and career decisions influenced childbearing. Thus, these issues are intertwined and it is important that we further understand how women incorporate information about reproductive health and career demands into their career and lifestyle decisionmaking.

This study has several notable strengths. First, it represents the largest study evaluating infertility in physicians and the first to study emergency physicians. Second, this study uses the NSFG to provide a cohort for comparison. CDC data are weighted to represent the general population and thus provide the largest, most comprehensive dataset on fertility and childbearing in the United States. Finally, the sample size is large enough to allow us to begin evaluating work-related factors that can potentially affect fertility and childbearing. Although our assessment of these issues was not exhaustive, it provides a starting point for a future, large-scale study aimed at evaluating work-related factors and infertility across both sexes.

Considering the current national focus on wellness and female physician retention, our study addresses an important issue in emergency medicine and medicine in general. Although this survey is a strong start, future research is necessary to identify the nature and magnitude of threats to reproductive health for both emergency medicine practitioners of both sexes. Overstating the effects of emergency medicine practice on reproductive health could have a significant negative impact on gender equality. Thus, it is critical that this issue be rigorously studied in collaboration with experts in occupational health,

reproductive health, and gender studies. Policy should focus on providing all practitioners with accurate information and work environments that employ methods to minimize risk to reproductive health.

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AUTHOR CONTRIBUTIONS

Melissa Parsons, Rosemarie Fernandez, and Colleen Kalynych conceived the study and obtained funding. All authors designed and revised the survey. Michelle Lott managed data collection. Tracy L. Johns and Michael J. Scicchitano provided statistical advice on study design and analyzed the data. Rosemarie Fernandez drafted the manuscript, and all authors contributed substantially to its revision. Rosemarie Fernandez takes responsibility for the paper as a whole.

CONFLICTS OF INTEREST

Melissa Parsons reports that her department received a grant from the University of Florida College of Medicine—Jacksonville; Colleen Kalynych reports grant funding to the University of Florida for her role as a co-investigator on a grant from the Department of Defense. Tracy L. Johns reports no conflict of interest. Michael J. Scicchitano reports no conflict of interest. Michelle Lott reports no conflict of interest. Rosemarie Fernandez reports grant funding to the University of Florida and the University of Washington to conduct research conceived and written by Rosemarie Fernandez from the Agency for Healthcare Research and Quality and the Department of Defense. Rosemarie Fernandez reports a grant internally funded by the University of Florida to conduct research conceived and written by Rosemarie Fernandez.

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AUTHOR BIOGRAPHY



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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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