

Research Article

Infertility, Fertility Preservation, and Access to Care During Training: A Nationwide Multispecialty Survey of United States Residents and Fellows

Ange Wang,¹ Christopher N. Herndon,² Evelyn Mok-Lin,¹ and Lusine Aghajanova³

¹Division of Reproductive Endocrinology and Infertility, Department of Obstetrics, Gynecology and Reproductive Sciences, University of California, San Francisco, CA 94158, USA

²Division of Reproductive Endocrinology and Infertility, Department of Obstetrics and Gynecology, University of Washington School of Medicine, Seattle, WA 98195, USA

³Division of Reproductive Endocrinology and Infertility, Department of Obstetrics and Gynecology, Stanford University School of Medicine, Sunnyvale, CA 94087, USA

Address correspondence to Lusine Aghajanova, aghajano@stanford.edu

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Abstract Purpose. To investigate the prevalence of and experience related to infertility and fertility preservation during training for United States (US) medical residents and fellows. **Methods.** Cross-sectional online-based survey study of US postgraduate residents and fellows. **Results.** Respondents included 732 residents and fellows, with the highest percentage in Obstetrics & Gynecology (24.2%), Pediatrics (14.1%), and Internal Medicine (13.9%). In total, over half of respondents (56.6%) reported delaying childbearing plans due to medical training, 51 (7.0%) reported infertility, while 11 (1.5%) reported recurrent pregnancy loss (RPL). 208 respondents (28.4%) had considered oocyte or embryo cryopreservation. Respondents reported lack of time/flexibility (35.4%) and financial concerns (29.4%) as the top reasons for being unable to pursue fertility treatment. **Conclusions.** The majority of residents and fellows in our survey delayed childbearing due to medical training, with time/flexibility and financial concerns the greatest barriers to fertility treatment during training. Specific measures are needed in order to increase access to fertility services for US medical trainees.

Keywords fertility preservation; infertility; residents; fellows; graduate medical education

1. Introduction

Issues relating to infertility and recurrent pregnancy loss (RPL) are highly relevant for medical trainees due to the timing, length, and inflexibility of medical training schedules, with many of them occurring during prime fertile years. Infertility is commonly defined as the inability to conceive after 12 months of regular unprotected intercourse under age 35, or inability to conceive after 6 months at age 35 or over [1]. RPL is defined as 2 or more pregnancy losses by the American Society for Reproductive Medicine (ASRM) and affects approximately 1–2% of the population [2]. Increasing maternal age has been strongly linked with both infertility and RPL, as well as an increased rate of pregnancy complications [3,4,5,6,7,8]. Despite strongly

established information as above, studies are very limited on infertility and fertility preservation in medical trainees.

Prior survey studies focused on Obstetrics & Gynecology residents have reported infertility rates comparable to the general population, low utilization of fertility preservation services, limited support from training programs for fertility preservation issues, and a high rate of postponement of childbearing due to medical training [9,10,11]. Several other survey-based studies in other medical fields (primarily surgical specialties) have reported qualitatively similar findings, including high rates of postponement of childbearing, concerns about maternal or fetal health as a result of training, and related career dissatisfaction [12,13,14,15,16]. Additionally, most existing studies have been conducted prior to the 2013 designation of oocyte cryopreservation as no longer being experimental by ASRM [17]. While reproductive age trainees postponing fertility are likely the prime target population for fertility preservation, the rate of uptake of this option and its accessibility in this group are unknown.

The objective of our study was to investigate the prevalence of and experience related to infertility and utilization of fertility preservation during training for United States (US) medical residents and fellows across multiple specialties. Our goal was to understand the current landscape in relation to these areas, as well as areas for potential improvement and increased awareness. To date, this is the first study on the subject of infertility and fertility preservation of US residents and fellows across all specialties.

2. Methods

This was a cross-sectional study, using an online-based survey distributed to US postgraduate residents and fellows

across multiple medical specialties using Qualtrics software. US residents and fellows were contacted online through several indirect methods: (1) a listserv of program directors and coordinators for all Obstetrics & Gynecology residency programs nationwide, (2) email addresses of program coordinators from large residency and fellowship programs across multiple specialties, obtained through the Accreditation Council for Graduate Medical Education (ACGME) website, and (3) Graduate Medical Education (GME) offices of large residency and fellowship programs. The only inclusion criteria were to be a fellow or resident in a US medical training program. Institutional Review Board (IRB) approval was obtained through Stanford University. Initial surveys were sent out via email from September 2018 to December 2018, with email reminders sent through March 2019. Survey reminders were sent out twice after the initial contact.

The current survey was based on an earlier published survey study of Obstetrics & Gynecology residents and their fertility needs (developed based on methods previously described) [9]. Our survey was expanded to include a section on fertility preservation given the ASRM designation of oocyte cryopreservation as no longer being experimental, as well as more detailed information on infertility experience, barriers, and support. The survey included 55 multiple choice and free-text questions over five sections (see Supplementary Index A—Survey) encompassing the following categories: (1) demographics, (2) reproductive characteristics, (3) infertility medical treatment, (4) fertility preservation, and (5) infertility experience during training. Due to a technical issue with the survey, age was not queried but other demographic variables were collected. Due to the sensitive nature of questions regarding reproductive history and medical training, all questions were optional and respondents could choose to not answer any question. As a result of this format of optional questions, we were unable to do a formal drop-out analysis. All responses are presented in the final survey, though some responses have been left blank either intentionally or unintentionally by respondents and presented as “Not answered” or “Not applicable”.

All respondents were displayed questions to Sections 1, 2, and 5 (though could leave any questions blank or select “Not applicable” given the sensitive nature of questions). For Section 3, questions were displayed for respondents who answered yes or don’t know to “experienced infertility or RPL in training.” For Section 4, questions were displayed for respondents who answered yes or other to “considered oocyte or embryo cryopreservation.”

Descriptive data analysis was performed in Qualtrics (available through our academic institution) and Microsoft Excel. We displayed descriptive statistics, percentages, means, standard deviations, and free text where relevant for qualitative, quantitative, and categorical questions (see Supplementary Index A—Survey). Free text responses are

provided in Supplementary Material (Index E—Selected free text comments) and grouped by theme, but further formal analysis was not possible due to small sample sizes for each question.

3. Results

3.1. Demographics (Table 1)

Respondents included 732 residents and fellows, with the highest percentage in Obstetrics & Gynecology (24.2%), Pediatrics (14.1%), and Internal Medicine (13.9%). 72.8% of respondents were residents and 73.2% were PGY1-4. Respondents were 75.4% female, 18.4% male, and 6.1% were transgender or not answered. The most common ethnicities were Caucasian (61.2%) and Asian/Pacific Islander (19.4%). The vast majority (75.8%) of respondents reported being married or partnered. In terms of sexual orientation, 86.9% of respondents were heterosexual, 2.6% were homosexual, and 3.4% were bisexual. For geographical location, 37.7% of respondents lived on the West Coast, 22.7% East Coast, 19.5% Midwest, and 10.5% South and Southeast. Only 13.1% reported living in a state where fertility coverage by insurance is mandated.

3.2. Reproductive characteristics (Table 2, Supplementary Index B)

In total, 79.8% of respondents reported having a partner, 10.0% reported no current partner, and the rest either unsure or not answered. The majority of respondents reported not currently trying to conceive (75.1%), while 10.1% reported trying to conceive < 1 year, and 3.7% reported trying to conceive for 1–3 years. 20.8% of respondents reported having been pregnant (or currently pregnant) during training, and 23.2% of respondents reported having a child (or currently pregnant) during training. In total, over half of respondents (56.6%) reported delaying childbearing plans due to medical training. 51 respondents (7.0%) reported current infertility, while 11 (1.5%) reported RPL. 28.4% of respondents reported that they had considered oocyte or embryo cryopreservation for fertility preservation; only a minority of respondents received any workup for ovarian reserve or fertility (12.3% lab tests, 12.3% semen analysis, and 9.7% ultrasound).

3.3. Fertility experience during training (Tables 3 and 4)

For Section 3, questions were displayed for respondents who answered yes or don’t know to “experienced infertility or RPL in training” ($N = 125$). For subjects who reported a history of infertility or RPL in residency (excluding not answered or not applicable responses), 54.8% of patients reported going for a consultation at a fertility center. The most common cause of fertility issues was unexplained (46.0%), followed by ovulatory dysfunction (11.1%), diminished ovarian reserve (9.5%), and RPL (9.5%). For those pursuing treatment, 19 respondents reported

Table 1: Demographics.

	N	Percentage		N	Percentage		N	Percentage
Specialty			Resident/fellow			Geographic location		
Anesthesia	39	5.3%	Resident	533	72.8%	West Coast	276	37.7%
Cardiac surgery	3	0.4%	Fellow	155	21.2%	Southwest	25	3.4%
Dermatology	21	2.9%	Not answered	44	6.0%	Midwest	143	19.5%
Emergency medicine	20	2.7%	Sex			South and southeast	77	10.5%
Family medicine	24	3.3%	Female	552	75.4%	East Coast	166	22.7%
General surgery	17	2.3%	Male	135	18.4%	Not answered	45	6.1%
Internal medicine	102	13.9%	Transgender/other	1	0.1%	Live in a state where fertility coverage by insurance is mandated*		
Neurological surgery	1	0.1%	Not answered	44	6.0%	Yes	96	13.1%
Neurology	16	2.2%	Race/ethnicity			No	547	74.7%
Obstetrics and gynecology	177	24.2%	Caucasian	448	61.2%	Not answered	89	12.2%
Ophthalmology	9	1.2%	Black/African-American	18	2.5%			
Oral and maxillofacial surgery	2	0.3%	Latino/Hispanic	25	3.4%			
Orthopedic surgery	13	1.8%	Asian/Pacific Islander	142	19.4%			
Other/not answered	58	7.9%	Native American	1	0.1%			
Other surgical subspecialty	8	1.1%	2 or more races	45	6.1%			
Otolaryngology	11	1.5%	Other	10	1.4%			
Pathology	15	2.0%	Not answered	43	5.9%			
Pediatrics	103	14.1%	Sexual orientation					
Plastic surgery	10	1.4%	Heterosexual	636	86.9%			
PM&R	6	0.8%	Homosexual	19	2.6%			
Psychiatry	21	2.9%	Bisexual	25	3.4%			
Radiation oncology	7	1.0%	Other	7	1.0%			
Radiology—diagnostic	32	4.4%	Not answered	45	6.1%			
Radiology—interventional	5	0.7%	Marital status					
Urology	12	1.6%	Married	407	55.6%			
Year of training			Partnered, not married	148	20.2%			
PGY1	106	14.5%	Single	126	17.2%			
PGY2	156	21.3%	Divorced	3	0.4%			
PGY3	166	22.7%	Other	3	0.4%			
PGY4	108	14.8%	Not answered	45	6.1%			
PGY5	68	9.3%	Combined annual household income					
PGY6	42	5.7%	< 40 K	1	0.1%			
PGY7	17	2.3%	40–60 K	147	20.1%			
PGY8 or above	12	1.6%	61–80 K	122	16.7%			
Not answered/other	57	7.8%	81–100 K	88	12.0%			
			100–200 K	247	33.7%			
			>200K	83	11.3%			
			Not answered	44	6.0%			

*As of 2018, these states are Arkansas, Connecticut, Hawaii, Illinois, Louisiana, Maryland, Massachusetts, Montana, New Jersey, New York, Ohio, Rhode Island, and West Virginia.

Table 2: Reproductive characteristics.

	N	Percentage		N	Percentage
Current partner			Have you or your partner considered oocyte or embryo cryopreservation for fertility preservation?		
Yes	584	79.8%	Yes	208	28.4%
No	73	10.0%	No	406	55.5%
Unsure	4	0.5%	Never heard of thought of it	29	4.0%
Not answered	71	9.7%	Other	11	1.5%
Have you delayed your childbearing plans due to residency/fellowship training?			Not answered or not applicable	78	10.7%
Yes	414	56.6%	Experienced infertility or RPL?* Select all that apply		
No	206	28.1%	Yes—infertility	51	7.0%
Unsure	35	4.8%	Yes—RPL	11	1.5%
Not answered	77	10.5%	No	452	61.7%
Have you or your partner done any tests for the specific purpose of assessing ovarian reserve or fertility? Select all that apply			Don't know	64	8.7%
Lab tests (i.e., AMH, FSH, estradiol)	90	12.3%	Not applicable	119	16.3%
Ultrasound	71	9.7%	Not answered	75	10.2%
Semen analysis	90	12.3%	Experienced infertility or RPL during or prior to training? Select all that apply		
None	544	74.3%	Both in training and prior to training	10	1.4%
Other	8	1.1%	During training	43	5.9%
Not answered or not applicable	81	11.1%	Prior to training	7	1.0%
			Not answered or not applicable	672	91.8%

*Infertility = inability to conceive for 12 months under age 35 or 6 months 35 or older, RPL = 2 or more miscarriages.

Table 3: Infertility medical treatment*.

	N	Percentage	Percentage** (excluding not answered or not applicable)		N	Percentage	Percentage** (excluding not answered or not applicable)
Did you and/or your partner go for consultation at a fertility center?				Number of IUI cycles completed			
Yes	46	36.8%	54.8%	Currently planning or in process	1	0.8%	9.1%
No	37	29.6%	44.0%	1	1	0.8%	9.1%
Other	1	0.8%	1.2%	2	0	0.0%	0.0%
Not answered or not applicable	41	32.8%		3	7	5.6%	63.6%
What was the cause of infertility? Select all that apply				4	0	0.0%	0.0%
Diminished ovarian reserve	6	4.8%	9.5%	5 or greater	2	1.6%	18.2%
Endometriosis	3	2.4%	4.8%	Not answered or not applicable	114	91.2%	
Male factor	7	5.6%	11.1%	What was the outcome of your fertility treatment? Select all that apply			
Ovulatory dysfunction including PCOS	9	7.2%	14.3%	Pregnant	12	9.6%	35.3%
RPL	6	4.8%	9.5%	Not pregnant	11	8.8%	32.4%
Tubal	0	0.0%	0.0%	Frozen oocytes	0	0.0%	0.0%
Uterine	2	1.6%	3.2%	Frozen embryos	7	5.6%	20.6%
Unexplained	29	23.2%	46.0%	Cycle canceled	0	0.0%	0.0%
Other	10	8.0%	15.9%	Currently in cycle	11	8.8%	32.4%
Not answered or not applicable	62	49.6%		Other	4	3.2%	11.8%
If you did have not yet had a fertility consultation, what is the most reason? Select all that apply				Not answered or not applicable	91	72.8%	
Don't think I need it yet	12	9.6%	36.4%	What was your satisfaction with the process of IVF for infertility? [1 = not satisfied at all, 5 = extremely satisfied]			
Don't have time	7	5.6%	21.2%	Average (SD)		(4.4, 1.0)	
Cannot afford	6	4.8%	18.2%	What was your satisfaction with the numbers of eggs or embryos that you were able to cryopreserve or retrieve (per IVF cycle)?			
Hoping I won't need it	17	13.6%	51.5%	Average (SD)		(4.3, 1.3)	
Other	4	3.2%	12.1%	What was your satisfaction with the process of IUI for infertility? [1 = not satisfied at all, 5 = extremely satisfied]			
Not answered or not applicable	92	73.6%		Average (SD)		(2.5, 1.3)	
Have you or your partner completed or are currently preparing for a stimulation cycle? Select all that apply				Are/were you able to afford the infertility treatment you need(ed)? Select all that apply			
Yes—In vitro fertilization (IVF) for infertility/RPL	19	15.2%	40.4%	No—unable to afford	3	2.4%	8.8%
Yes—IVF for oocyte cryopreservation	1	0.8%	2.1%	Yes, my salary was sufficient to support the costs	6	4.8%	17.6%
Yes—IVF for embryo cryopreservation	3	2.4%	6.4%	My partner's salary helped to support the costs	12	9.6%	35.3%
Yes—Intrauterine Insemination (IUI)	11	8.8%	23.4%	My parents/friends helped to support the costs	5	4.0%	14.7%
Yes—oral medications	14	11.2%	29.8%	My or partner's insurance helped to support the costs	19	15.2%	55.9%
No	12	9.6%	25.5%	Other	3	2.4%	8.8%
Not answered or not applicable	78	62.4%		Not answered or not applicable	91	72.8%	
[If no to above] Why did you decide not to pursue fertility treatment after consultation? Select all that apply				What have been your out of pocket costs to date for infertility?			
Financial reasons	6	4.8%	54.5%	< \$1,000	0	0.0%	0.0%
Lack of insurance	1	0.8%	9.1%	\$1,000—< \$5,000	1	0.8%	50.0%
Lack of time/flexibility	3	2.4%	27.3%	\$5,000—< \$10,000	0	0.0%	0.0%
Not interested at this time	2	1.6%	18.2%	\$10,000—< \$20,000	0	0.0%	0.0%
Other	3	2.4%	27.3%	> \$20,000	1	0.8%	50.0%
Not answered or not applicable	114	91.2%		Not answered or not applicable	123	98.4%	
Where did you or your partner receive infertility or fertility preservation treatment? Select all that apply				Did you get any discounts at the facility as a courtesy for being a resident or fellow?			
University clinic	17	13.6%	48.6%	Yes	0	0.0%	0.0%
Private clinic	16	12.8%	45.7%	No	3	2.4%	100.0%
Same hospital I work at	4	3.2%	11.4%	Don't know	0	0.0%	0.0%
Other	1	0.8%	2.9%	Not answered or not applicable	122	97.6%	
Not answered or not applicable	90	72.0%		Did you have insurance coverage for IVF for infertility?			
Number of IVF cycles completed				Yes	10	8.0%	55.6%
Currently planning or in process	5	4.0%	22.7%	Partial	1	0.8%	5.6%
1	10	8.0%	45.5%	No	7	5.6%	38.9%
2	6	4.8%	27.3%	Not answered or not applicable	107	85.6%	
3	0	0.0%	0.0%	Did you have insurance coverage for IUI?			
4	0	0.0%	0.0%	Yes	7	5.6%	63.6%
5 or greater	1	0.8%	4.5%	Partial	1	0.8%	9.1%
Not answered or not applicable	103	82.4%		No	3	2.4%	27.3%
				Not answered or not applicable	114	91.2%	

*Respondents who answered yes or don't know to "experienced infertility or RPL in training," N = 125 with 1 overlapping response (RPL and infertility).

**Excluding not answered or not applicable. Questions in this section were displayed to all respondents who had infertility or RPL during training. All questions were optional.

Table 4: Fertility preservation*.

	N	Percentage	Percentage** (excluding not answered or not applicable)		N	Percentage	Percentage** (excluding not answered or not applicable)
Did you and/or your partner go for consultation at a fertility center?				What was the outcome of your fertility treatment? Select all that apply			
Yes	46	21.0%	27.4%	Pregnant	7	3.2%	23.3%
No	117	53.4%	69.6%	Not pregnant	5	2.3%	16.7%
Other	5	2.3%	3.0%	Frozen oocytes	10	4.6%	33.3%
Not answered or not applicable	51	23.3%		Frozen embryos	7	3.2%	23.3%
[If no to first question] Why did you decide not to pursue a consultation for oocyte or embryo cryopreservation despite interest? Select all that apply				Cycle canceled	0	0.0%	0.0%
Financial reasons	54	24.7%	49.5%	Currently in cycle	6	2.7%	20.0%
Lack of insurance	13	5.9%	11.9%	Other	2	0.9%	6.7%
No current partner	13	5.9%	11.9%	Not answered or not applicable	189	86.3%	
Lack of time/flexibility	47	21.5%	43.1%	What was your satisfaction with the process of egg or embryo cryo? [1 = not satisfied at all, 5 = extremely satisfied]			
Not interested at this time	40	18.3%	36.7%	Average (SD)	3.8 (1.2)		
Other	17	7.8%	15.6%	What was your satisfaction with the numbers of eggs or embryos that you were able to cryopreserve or retrieve (per IVF cycle)?			
Not answered or not applicable	110	50.2%		Average (SD)	3.5 (1.3)		
Have you or your partner completed or are currently preparing for a stimulation cycle? Select all that apply				Are/were you able to afford the infertility treatment you need(ed)? Select all that apply			
Yes—IVF for infertility/RPL	11	5.0%	21.6%	No—unable to afford	6	2.7%	20.0%
Yes—IVF for oocyte cryopreservation	12	5.5%	23.5%	Yes, my salary was sufficient to support the costs	8	3.7%	26.7%
Yes—IVF for embryo cryopreservation	6	2.7%	11.8%	My partner's salary helped to support the costs	5	2.3%	16.7%
Yes—IUI	4	1.8%	7.8%	My parents/friends helped to support the costs	6	2.7%	20.0%
Yes—oral medications	5	2.3%	9.8%	My or partner's insurance helped to support the costs	10	4.6%	33.3%
No	20	9.1%	39.2%	Other	7	3.2%	23.3%
Not answered or not applicable	168	76.7%		Not answered or not applicable	189	86.3%	
[If no to above] Why did you decide not to pursue oocyte or embryo cryopreservation after consultation? Select all that apply				What have been your out of pocket costs to date for infertility?			
Financial reasons	9	4.1%	64.3%	< \$1000	2	0.9%	66.7%
Lack of insurance	2	0.9%	14.3%	\$1,000—< \$5,000	0	0.0%	0.0%
No current partner	1	0.5%	7.1%	\$5,000—< \$10,000	0	0.0%	0.0%
Lack of time/flexibility	10	4.6%	71.4%	\$10,000—< \$20,000	1	0.5%	33.3%
Not interested at this time	4	1.8%	28.6%	> \$20,000	0	0.0%	0.0%
Other	2	0.9%	14.3%	Not answered or not applicable	216	98.6%	0.0%
Not answered or not applicable	205	93.6%		Did you get any discounts at the facility as a courtesy for being a resident or fellow?			
Where did you or your partner receive infertility or fertility preservation treatment? Select all that apply				Yes	1	0.5%	25.0%
University clinic	21	9.6%	67.7%	No	3	1.4%	75.0%
Private clinic	9	4.1%	29.0%	Don't know	0	0.0%	75.0%
Same hospital I work at	8	3.7%	25.8%	Other	0	0.0%	75.0%
Other	1	0.5%	3.2%	Not answered or not applicable	215	98.2%	
Not answered or not applicable	188	85.8%		Did you have insurance coverage for oocyte or embryo cryopreservation?			
Number of IVF cycles completed				Yes	4	1.8%	22.2%
Currently planning or in process	5	2.3%	18.5%	Partial	4	1.8%	22.2%
1	14	6.4%	51.9%	No	10	4.6%	55.6%
2	7	3.2%	25.9%	Not answered or not applicable	201	91.8%	
3	1	0.5%	3.7%	Do you plan to delay your childbearing because of the ability to perform oocyte or embryo cryopreservation?			
4	0	0.0%	0.0%	Yes	6	2.7%	35.3%
5 or greater	0	0.0%	0.0%	Maybe	4	1.8%	23.5%
Not answered or not applicable	192	87.7%		No	7	3.2%	41.2%
				Not answered or not applicable	202	92.2%	

*Respondents who answered yes or other to "considered oocyte or embryo cryopreservation" $N = 219$.

**Excluding not answered or not applicable. Questions in this section were displayed to all respondents who expressed interest in fertility preservation. All questions were optional.

undergoing IVF, 11 reported undergoing IUI, and 14 reported using oral medications for fertility purposes. 35.3% of respondents reported becoming pregnant from their fertility treatment, 32.4% reported not achieving pregnancy, with the remainder currently in cycle. Respondents reported overall high satisfaction with IVF treatment for infertility

(4.4 ± 1.0 , on a scale of 5) though lower satisfaction with IUI (2.1 ± 1.3). In terms of financial coverage for infertility, 55.9% of respondents reported that their or their partner's insurance helped cover the costs, and 35.3% reported their partner's salary helped support the costs. 11/19 (57.9%) respondents reported full or partial insurance coverage for

Table 5: Infertility experience during training.

	<i>N</i>	Percentage	Percentage* (excluding not answered or not applicable)
Did your colleagues and/or program know about your struggles with infertility or desire for fertility preservation?			
Yes (only colleagues)	37	5.1%	14.5%
Yes (only program administration)	3	0.4%	1.2%
Yes (both colleagues and program administration)	22	3.0%	8.6%
No	167	22.8%	65.5%
Other	26	3.6%	10.2%
Not answered or not applicable	477	65.2%	
Did you feel stigmatized by your colleagues and/or friends for having an issue with infertility or for desiring fertility preservation?			
Yes	6	0.8%	7.5%
No	65	8.9%	81.3%
Other	9	1.2%	11.3%
Not answered or not applicable	652	89.1%	
Were your residency program administrators supportive?			
Very supportive	27	3.7%	11.2%
Somewhat supportive	9	1.2%	3.7%
Minimally supportive	6	0.8%	2.5%
Not supportive	2	0.3%	0.8%
Unaware of treatment	189	25.8%	78.4%
Other	8	1.1%	3.3%
Not answered or not applicable	491	67.1%	
Were your residency program colleagues supportive?			
Very supportive	49	6.7%	20.4%
Somewhat supportive	11	1.5%	4.6%
Minimally supportive	5	0.7%	2.1%
Not supportive	2	0.3%	0.8%
Unaware of treatment	163	22.3%	67.9%
Other	10	1.4%	4.2%
Not answered or not applicable	492	67.2%	
Did your work schedule allow you to go through fertility treatment?			
Yes, with no difficulty	6	0.8%	8.1%
Yes, with some difficulty	30	4.1%	40.5%
Yes, with great difficulty	14	1.9%	18.9%
No, it was not possible for me to make the appointments	14	1.9%	18.9%
Other	168	23.0%	13.5%
Not applicable, did not seek treatment or not treated during training	10	1.4%	
Not answered or not applicable	490	66.9%	
A trainee discount would help with the costs of undergoing assisted reproductive technologies during training			
Strongly agree	431	58.9%	70.0%
Somewhat agree	115	15.7%	18.7%
Indifferent	32	4.4%	5.2%
Somewhat disagree	2	0.3%	0.3%
Strongly disagree	2	0.3%	0.3%
No opinion	34	4.6%	5.5%
Not answered or not applicable	116	15.8%	
In your opinion, what is the biggest barrier to pursuing fertility treatments while in training?			
Time	259	35.4%	41.8%
Money	215	29.4%	34.7%
Lack of information	26	3.6%	4.2%
Lack of partner	17	2.3%	2.7%
Emotional reasons	9	1.2%	1.5%
Geographical reasons (i.e., partner in different location)	5	0.7%	0.8%
Other	25	3.4%	4.0%
No opinion	63	8.6%	10.2%
Not answered or not applicable	113	15.4%	18.3%

*Excluding not answered or not applicable.

IVF for infertility, and 8/11 (72.7%) respondents reported full or partial coverage for IUI for infertility.

For Section 4, questions were displayed for respondents who answered yes or other to “considered oocyte or embryo cryopreservation” ($n = 219$). 208 respondents (28.4% of total) reported that they had considered oocyte or embryo cryopreservation, though only 46/208 (22.1%) respondents underwent a fertility consultation for this purpose. For those not pursuing a consultation, the most common reasons were financial and lack of time/flexibility. 18/46 (39.1%) respondents that went through a consult reported undergoing IVF for embryo or oocyte cryopreservation. Of those able to go through treatment, respondents most commonly reported their own insurance or partner’s insurance as the source of financial support. Respondents reported an average satisfaction of 3.8 ± 1.2 with the process of IVF for egg or embryo cryopreservation, and average satisfaction of 3.5 ± 1.3 on the number of eggs/embryos retrieved per cycle. Respondents were split on whether or not they planned to delay childbearing due to ability to cryopreserve embryos or oocytes (35.3% Yes, 23.5% No, 41.2% Maybe).

3.4. Management of fertility during training (Table 5)

In terms of managing their fertility journey during training, respondents reported lack of time/flexibility (35.4%) and financial concerns (29.4%) as the top reasons for being unable to pursue either fertility consultation or treatment. The majority of respondents (65.5%) experiencing infertility/RPL or desire for fertility preservation reported that colleagues and program administration were unaware of treatments and/or struggles. However, of those whose challenges were known, the majority felt some degree of support by their program administrators (80.8%) and colleagues (84.4%). Respondents reported that their training work schedule made it difficult to go through treatment (40.5% with some difficulty, 18.9% with great difficulty, 18.9% not possible to make treatments). The majority of respondents (70.0%) strongly agreed that a trainee discount would help with the cost of undergoing assisted reproductive technologies during training. Additional detailed information is presented in Supplementary Material on stratification for Surgical versus Nonsurgical specialties (Supplementary Index C) and Residency versus Fellows (Supplementary Index D), with similar themes between the groups.

Tables Note: due to the fact that some questions were “Select all that apply” and that no questions were mandatory, some percentages do not add up to 100%.

4. Discussion

This is the first survey of US postgraduate residents and fellows across medical specialties on reproductive characteristics, infertility, and fertility preservation. In our survey, we found that majority of medical trainees (56.6%)

reported delaying childbearing due to medical training. However, those interested in fertility experience infertility and RPL at comparable rates to the general population, with overall rates reported of 7.5% and 1.1%, respectively, in our survey (compared to 11% and 2–3% of general population; our rates may be under-reported due to the fact that not all participants have attempted childbearing). We found a relatively low rate of utilization of services for infertility or fertility preservation and multiple associated barriers (time and money being the most pronounced). While our stratified data found that these issues are somewhat more pronounced for surgical specialties (likely due to even less time flexibility for these specialties) and for fellows (likely due to the older average age), these themes were persistent across all fields and levels of training. The majority of respondents experiencing infertility/RPL or desire for fertility preservation did not share these issues with their programs. Further research should seek to validate these findings in larger cohorts. Though our survey focused on highlighting issues important for medical trainees specifically, another future research direction is to also investigate how infertility, RPL, and utilization and attitudes towards fertility preservation differ in relation to the general population and other occupations.

It is estimated that impaired fecundity affects 67 million women in the US, approximately 11% of the reproductive-age population [18]. Survey estimates of infertility have ranged from 12% to 18% of the population [19], with a CDC survey finding that 6% of married women (1.5 million) in the US are infertile [18]. RPL is more uncommon, with an estimated 2–3% of women experiencing two or more consecutive pregnancy losses [20]. Studies have suggested that for those who delay childbearing, there is a tendency to underestimate the impact of age on fertility in the future [21, 22, 23, 24]. Despite these issues, there are limited studies on infertility or fertility preservation for medical trainees, with many of these studies conducted before fertility preservation options being commonly available. In 2013, ASRM designated oocyte cryopreservation as no longer being an experimental technology, and the rate of utilization of fertility preservation services has steadily increased since that time [17].

Several prior surveys have sought to investigate the fertility issues facing medical trainees, mostly for specific subspecialties. Our earlier study of 241 Obstetrics & Gynecology residents reported an infertility rate of 8%, utilization of fertility preservation services of 2%, and that the majority of residents facing fertility issues felt little or no support from their programs [9]. Another survey of 113 Obstetrics & Gynecology residents and fellows reported that 71.8% postponed childbearing due to medical training, and that only half of female residents felt comfortable educating patients about oocyte cryopreservation [10]. A separate study of 238

Obstetrics & Gynecology residents reported that 83% of respondents felt that it was important to address age-related fertility decline with patients, and that residents were much more likely to support oocyte cryopreservation in cancer patients compared to elective cryopreservation [11].

Beyond Obstetrics & Gynecology programs, surveys of residents in other specialties (primarily surgical) on fertility and pregnancy have found similar themes. A survey of 113 thoracic surgeons (both residents and attendings) found that women were significantly more likely than men to delay childbearing or feel that their career would be adversely impacted. 28% of women in that survey utilized ART with a significantly higher age at first childbirth (34.3 ± 0.7 years, national average 25.4) [12]. A study of 347 Surgery residents reported that 63.6% were concerned that their work schedule adversely impacted the health of either themselves or their fetuses, and that nearly 40% considered leaving their surgical residency [13]. A separate study from this cohort found that over 50% of pregnant surgical residents expressed at least some career dissatisfaction (particularly those who perceived stigma during pregnancy) lacked a maternity leave program or altered their fellowship plans [14]. A survey of 199 plastic surgery residents and program directors found that there was a 57% overall pregnancy complication rate, a 26% elective abortion rate, and 33% infertility rate, higher than reported in general literature [15]. Another survey of general women surgeons reported a large stigma associated with pregnancy during training [16]. Nevertheless, despite the growing body of literature, data is still limited on this topic, particularly on the subjects of fertility and fertility preservation. In our nationwide survey of 732 US residents and fellows, we found that there was a 7% reported prevalence of infertility and 1.5% prevalence of RPL, which may be underestimated as over 50% of respondents reported delaying childbearing due to training. These figures are comparable to what has been reported in the general population, as well as some past surveys on this topic. The majority of our respondents were female, partnered, and residents in Obstetrics & Gynecology, Internal Medicine, and Pediatrics, though a wide variety of specialties were represented.

For those experiencing infertility or RPL, less than half of respondents reported going to an infertility consultation, with the most common etiology of infertility being unexplained. In terms of fertility preservation, while over 25% of respondents expressed interest in oocyte or embryo cryopreservation, less than a quarter of those respondents (22.1%) went for consultation for fertility preservation, and only 18/46 (39.1%) of the latter respondents reported undergoing IVF for either embryo or oocyte cryopreservation. Remarkably, the rates of those utilizing fertility preservation services were higher than those reported in our earlier study [9], where 29% considered fertility

preservation but only 2% sought consultation. This may be due to additional time elapsing since ASRM removed the experimental label on oocyte cryopreservation in 2013, and a corresponding increase in awareness, interest, and improvement in technology since then.

However, compared to our prior study, the percentage of the infertile population utilizing infertility treatments was lower in this study, which may be due to the aforementioned barriers to treatment. Reported barriers to infertility treatment were similar between our study and the prior study, with financial concerns and time reported as the largest barriers. Respondents undergoing cryopreservation were split on whether or not the ability to do so would lead them to voluntarily delay childbearing. In general, this is novel and important information since very few other studies have investigated fertility preservation among medical trainees.

As already mentioned, the largest reported barriers to pursuing fertility treatments while in training were time/flexibility and financial consideration. Most residents reported that their work schedule made going to treatments difficult or impossible. One of the reasons for this could be the fact that most of trainees did not share their fertility desires and struggles with the program. However, for those whose challenges were known, over 80% felt some degree of support by their program administrators and colleagues, an improvement compared to what has been reported in prior surveys. Free-text comments from the survey also vocalized many of these concerns, including cost of fertility treatments and childcare, lack of time and flexibility, lack of information available on fertility preservation, associated stress, and difficulty in discussing this topic with administration; however, some also vocalized caution about fertility preservation support in training, and instead the need rather for better pregnancy and parental leave policies in training (see Supplementary Index E—Selected free text comments).

Our findings, in conjunction with prior studies, highlight the fact that infertility and fertility preservation are issues that are encountered by a significant portion of medical trainees across multiple specialties, and that the majority of trainees delay childbearing due to their medical career. Given the reported barriers to seeking fertility treatments in training, there is a need for possibly redesigning training curriculums to allow for time and flexibility for pursuing fertility treatments (which may be relevant for medical conditions beyond fertility as well). Additionally, financial barriers were reported as an issue by many respondents and are affected by multiple factors, including insurance coverage, mandated coverage depending on state of residence, and resources from partners or parents; additional financial resources such as a GME or hospital- or clinic-based discount for medical trainees would likely be beneficial for many trainees. While most trainees did not feel comfortable sharing their fertility struggles with either administration

or colleagues, it is encouraging that the ones who shared their issues mostly received support, which is a change from what has been reported in some earlier surveys, even as late as 2017. Similarly, respondents in our survey reported less stigma compared to prior surveys, suggesting that there may be improvement underway in some of these areas [9].

Strengths and limitations

The strengths of the study include the relatively large sample size, the wide distribution of medical specialties represented, and the ability to stratify responses by surgical/nonsurgical and resident/fellow status. Additionally, we were able to collect detailed information on reproductive history, infertility history, and fertility treatment and preservation. Other studies in this area have usually focused only on one specialty, and/or have not been able to assess fertility preservation aspect given that this is a relatively new field.

A significant limitation of the study is the fact that we were unable to report on age due to a technical issue with the survey, as age is the biggest predictor of fertility [25]. Though we do not know the exact age for our respondents, we do have access to the distribution of responses by PGY year and specialty (see Table 1). The majority of responses are PGY1-4 (over 70%), and the most represented specialties are Obstetrics & Gynecology, Internal Medicine, and Pediatrics. According to the ACGME [26], in 2018–2019 the average overall PGY1 age across all specialties was 30.7 years (28.7 Obstetrics & Gynecology, 29.6 Internal Medicine, and 29.0 Pediatrics). Therefore, we can extrapolate that the average age of our respondents was likely around 32–33 and was distributed across multiple PGY years with a majority in PGY1-4 (as expected, due to the fact that many specialties only have a 3–4 year residency), which is fairly representative of the general trainee population in terms of average age. Future research should specifically investigate the impact of age on fertility treatment and prevalence among medical trainees.

Another limitation of the study was that while study size was relatively large, we could not calculate the response rate and our sample size was still limited compared to all potential respondents. Surveys were sent through the three intermediate email channels as described in Section 2 as there is no direct listserv of all medical trainees in the US or a way to access all individual emails. The vast majority of GME and program coordinators did not provide confirmation that they received our email or forwarded the survey on to their constituents; so as a result of indirect distribution methods, we did not have a way to know many trainees who actually received the survey. We did receive a final sample size of $N = 732$ among a variety of specialties (see Section 3), but indirect distribution methods precluded us from knowing the final number of respondents. These distribution methods are similar to prior literature on surveys on this or a similar subject, as unfortunately a direct distribution method

is not available for such a wide population. Due to indirect distribution methods, the exact number of potential respondents receiving the survey is unknown. Thus, the response rate cannot be accurately calculated. The highest number of respondents was in Obstetrics and Gynecology, which was likely due to the fact that we had access to a listserv of all program coordinators nationwide (not available for other specialties). According to the ACGME, in 2017–2018 there were total 135,326 active residents and fellows, though it is very likely that only a minority of these residents and fellows received the survey (see more in Section 4). Reasons for a low response rate among people who received the survey could have included survey fatigue (due to many surveys being distributed to trainees), busy training schedule leading to emails being missed, lack of interest/relevance of this topic particularly among younger trainees, and reluctance to disclose personal information.

In addition, the survey had 75% female respondents, likely due to a high number of Obstetrics & Gynecology respondents, which is a field with majority female trainees (as we had access to an Obstetrics & Gynecology program coordinator listserv, and this subject is particularly relevant for Obstetrics & Gynecology which encompasses fertility preservation). Also, fertility preservation in regards to oocyte cryopreservation is more relevant for female trainees, though we made sure to include questions about partners as this is relevant to both sexes. Surveys are always subject to selection bias in that participants can choose whether or not to participate, and these all are the plausible reasons for why our survey had 75% female respondents. However, a high percentage of female respondents was also found in many previous studies on fertility preservation, likely due to similar factors.

Therefore due to the above, we cannot generalize our findings and conclusions to the entire medical trainee population which is substantially larger than our sample size. Other studies, though, have also found similar findings, including deferment of childbearing and associated barriers for medical trainees [9,15,16]. Therefore, we believe the common themes emerging from our study still have merit in raising awareness around the prevalence of infertility/RPL among medical trainees as well as the need for additional resources for this population, and are important to inform GME policy in the future. Additionally, our survey size is still larger than other prior studies of similar subject in medical trainees, and the largest study on this subject [9, 10, 11, 12, 13, 14, 15]. However, further study is needed in larger samples to validate and generalize these findings across medical trainees.

5. Conclusions

The majority of residents and fellows in our survey delayed childbearing due to medical training. The reported infertility

rate in postgraduate medical trainees is comparable to the general population, though it may be underestimated as individuals which may further delay childbearing until established in practice. Time/flexibility and financial concerns were identified by residents and fellows as the greatest barriers to seeking and pursuing medical assistance while in training. Further research should investigate these themes in a larger, more representative cohort given the high number of medical trainees in the country. Future research efforts should also use a multivariate analysis to investigate if demographic factors are associated with fertility treatment, fertility preservation or barriers to access care; this will improve understanding of which factors affect reproductive treatment among residents and fellows.

Our survey, in conjunction with prior literature, suggests that there is a need for increased awareness of infertility and fertility preservation issues for medical trainees. In addition, there should be establishment of more resources and support in this area, particularly given the well-established age-related decline in fertility and increased obstetrical complications with increasing maternal age. As access to health care is an important issue nationwide and globally, it is critical to help advocate for access to fertility treatment and fertility preservation for our own trainees, as these are vital issues which deeply impact their lives. As stated by one of the respondents, “... it is OBGyn and we should be leading the charge in making work places progressive places for women and understanding that waiting until I graduate is never what you would recommend to your own patient in my position.”

Data presentation These data were presented in part as a poster presentation at the ASRM 2019 in Philadelphia, PA, USA.

Ethics approval This study has obtained IRB approval through Stanford University.

Authors' contributions All authors were involved in study conception and design. A. Wang performed the data analysis. L. Aghajanova and A. Wang performed initial data interpretation. A. Wang wrote the initial draft of the manuscript. All authors contributed to additional data interpretation and final approval of the manuscript.

Conflict of interest The authors declare that they have no conflict of interest.

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