

Exploring the need for fertility education: A cross-sectional study of healthcare professionals and students' knowledge of fertility and fertility preservation

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Abstract

Introduction: Increasing attention has been directed toward fertility and fertility preservation (both for medical and non-medical reasons) worldwide. Nevertheless, previous studies have reported a lack of fertility awareness in the general population, healthcare providers, and medical students. This study aimed to explore health professionals' and students' fertility knowledge, fertility preservation knowledge and attitudes, and interest in accessing more information.

Methods: The sample consisted of 309 participants (214 students; 95 professionals) from medicine, nursing, and psychology. Participants completed an online questionnaire addressing knowledge about fertility and fertility preservation, attitudes towards fertility preservation, and interest in receiving more information.

Results: Most participants were aware of the infertility definition and prevalence, but 41.2% of students and 37.9% of professionals needed to recognize that men's age may also impact fertility. Concerning *in vitro* fertilization (IVF) success rates, 38.3% of students and 35.8% of professionals underestimated the IVF success rates, whereas 33.2% and 27.8%, respectively, overestimated these rates. Participants' answers regarding factors affecting fertility showed that more than half of the participants, more than half of the students (54.6%), and the professionals (60%) overestimated the age of women's fertility decline. Oocyte cryopreservation was the fertility preservation option they knew best. Health professionals and students mostly agreed that providing fertility preservation information should be part of regular healthcare and mentioned that receiving information about fertility preservation would be helpful. Professionals revealed higher knowledge when compared to students.

Conclusions: Overall, despite having some information, professionals and students still lack sufficient knowledge to support their patients. These results highlight the relevance of designing training and information opportunities to enhance knowledge on the topics of fertility awareness and fertility preservation.

Take-home message: Health professionals and students were willing to receive information about fertility preservation. This study provides targets for designing training and information opportunities to enhance knowledge on the general topic of fertility awareness and fertility preservation for health professionals and students.

Keywords: Fertility; fertility preservation; knowledge; health professionals; students.

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INTRODUCTION

According to the Centers for Disease Control and Prevention, in the United States of America (USA), the mean age at which women become mothers increased from 24.9 to 26.3 years old between 2000 and 2014 [1]. Eurostat data also reported that the mean age of women at the birth of their first child has gradually increased, being 28.8 years old in 2013 and 29.3 years old in 2018 [2].

The postponement of parenthood may be due to factors such as social changes associated with gender roles, and a higher freedom for women to decide when to have their first child as a result of the possibility of family planning associated with the contraceptive pill [3] and other effective contraceptive methods. Factors such as higher levels of education [3], professional aspirations [4], the pursuit of a career, financial issues [3, 4], housing search, and relationships tending to be less durable can also be pointed to as possible factors involved in the delay of parenthood [5]. Delaying childbearing impacts fertility, as age significantly affects fertility, especially in women, and there is an inverse relationship between ageing and oocyte quantity and quality [6]. Despite these changes in

the different contexts of individuals' and couples' lives, they still need to fully understand the impact of postponing parenthood on fertility, namely the risk of infertility [4,7,8].

Fertility preservation provides a means of potentially circumventing the impact of age on the natural process of reproductive ageing [9]. Fertility preservation offers women the possibility of increasing their options for reproductive health planning, preventing, to some extent, age-related subfertility [10]. Moreover, fertility preservation should be considered before gonadotoxic treatment when medical conditions threaten future fertility. Health plays a crucial role in fertility, and diseases such as cancer, specific autoimmune diseases, and systemic hematologic diseases requiring potentially gonadotoxic treatments (e.g., chemotherapy, radiation therapy, or surgery) or premature ovarian insufficiency may also compromise the individual's reproductive future [11]. Therefore, it is recommended that health professionals [e.g., general practitioners (GPs), oncologists, and surgeons] discuss fertility preservation options with their patients, particularly with those who have not completed their parental project, as soon as possible before starting treatment, to ensure the best strategy for preserving their fertility [12].

The demand for fertility preservation, for medical and non-medical reasons, has increased over the last few years. More recently, due to reproductive medicine developments, several female and male fertility preservation options have become available [12]. Pre- or post-pubertal fertility preservation techniques include embryo, oocyte, and sperm cryopreservation, ovarian transposition, and ovarian and testicular tissue cryopreservation [12].

Previous studies conducted on female graduate students, undergraduate students, and medical students (mainly nulliparous) showed that they have not usually reflected on their fertility, and many women, although recognizing the relevance of age in fertility, revealed poor knowledge about their reproductive system and a lack of understanding of age-related fertility decline [4, 13]. Due to the improvement of assisted reproductive technologies (ART), women may feel reassured by the false belief that ART is effective regardless of age. This may lead to increasingly seeking these treatments at older ages in the face of an age-related infertility diagnosis [3-5, 7]. Therefore, it is essential that individuals of childbearing age have access to correct and adequate fertility information [4]. The same applies to the knowledge of the different methods for preserving fertility [4] so that they can make informed decisions and balance the risks to which they may be exposed, either by possible diseases and their treatments, consequences of their lifestyle habits, and/or postponement of childbearing [14].

A study addressing the Portuguese general population's knowledge about fertility and the desire to have children concluded that the knowledge of the men and women was low despite their desire to become parents [7]. The majority of women who intended to have children in the future identified health professionals as the preferred and most reliable source for obtaining information about their reproductive health, compared to other sources such as the Internet, peers, or the media; however, only 30% mentioned recurring to their GPs when searching for more information [7]. This finding reinforces the need for healthcare providers to take the initiative to address reproductive health and fertility topics during their consultations [7]. Another study also reported that a significant percentage of women were willing to preserve their fertility in the future and identified trusting their obstetrician-gynecologist (Ob/Gyn) to provide them with information and initiate conversations about fertility preservation [4]. Nevertheless, the study also pointed out that healthcare professionals may benefit from more knowledge and experience, potentially overlooking an opportunity to provide

comprehensive education to their patients by focusing solely on preventing unwanted pregnancies during family planning discussions [4].

Several studies showed insufficient knowledge about fertility among the general population [7] or college students [4], and this lack of knowledge was also observed in medical students and health professionals [13]. Mahesan, Sadek, and Ramadan (2019) assessed fertility knowledge and attitudes of general college students and medical students and found that both groups lacked knowledge regarding age-related changes in fertility [13]. Furthermore, a study aiming to assess the knowledge, attitudes, and intentions of Ob/Gyn residents in the U.S.A. reported that most respondents recognized that age-related fertility decline should be discussed annually with female patients but did not consider it relevant to do so regarding oocyte cryopreservation [14]. The study also identified a need for more knowledge among Ob/Gyn residents about fertility issues [14]. Similar results were reported in more recent studies; for example, Demir et al. (2020) found low knowledge levels about oocyte cryopreservation among primary care health professionals [15]. This lack of knowledge may directly compromise the support provided by healthcare professionals to their patients, regardless of their reasons for seeking fertility preservation, highlighting the need for providing more education on this topic during medical training [15].

In Portugal, a study aimed at investigating practice patterns of oncologists regarding female fertility preservation revealed that although these professionals mentioned discussing the reproductive future with their patients, 2.8% stated that they were never informed about the risk of infertility, and 7.2% about fertility preservation, respectively [16]. Furthermore, 75.8% of the oncologists reported referring fewer than ten patients to a reproductive medicine colleague. Studies addressing the perception of fertility and fertility preservation knowledge in healthcare professionals (physicians, nurses, and psychologists) and students of these health areas are scant. Therefore, the current study aimed to explore perceptions of general knowledge regarding fertility and factors affecting fertility, fertility preservation knowledge and attitudes, and the extent to which health professionals and students would be interested in accessing more information concerning fertility preservation. Comparisons between professionals and students were also examined.

METHODS

Study design and participants

In this cross-sectional study, a convenience sample ($N = 309$) encompassing 214 students was chosen, with the following specializations: medicine ($n = 102$), nursing ($n = 29$), and psychology ($n = 83$), and 95 professionals: medical doctors ($n = 41$), nurses ($n = 35$) and psychologists ($n = 19$). Students attended a bachelor's degree/graduate ($n = 140$; 65.42%) or a master's degree ($n = 74$; 34.58%). The students' subsample included 181 women (84.6%) and 33 men (15.4%), with an age range from 18 to 36 ($M = 21.18$; $SD = 2.38$) and a mean of 13.99 ($SD = 1.29$) years of education. They were mainly single ($n = 210$; 98.1%), and four (1.9%) were married or living with a partner. The professional subsample encompassed 80 (84.2%) women and 15 (15.8%) men with an age range from 22 to 62 ($M = 36.39$; $SD = 12.75$) and a mean of years of education of 17.25 ($SD = 1.61$). Fifty-six (58.9%) participants were single, 31 (32.6%) were married or living with a partner, and 8 (2.6%) were divorced. Health professionals were working mainly in the public sector ($n = 60$; 19.4%), 16 (5.2%) were working in the private sector, 16 (5.2%) were working both in the public and private sectors, and 3 (1%) were currently unemployed.

Study measures

This study used two questionnaires. The first was a sociodemographic/professional questionnaire that addressed the following variables: sex, age, marital status, professional status, scientific area, years of education, and work setting.

Based on similar studies [4,8,14,15,17] and considering the study aims, a specific questionnaire was designed to address (1) general knowledge regarding fertility, (2) knowledge about factors affecting fertility, (3) fertility preservation knowledge, (4) attitudes towards fertility preservation, and (5) desire for information in fertility preservation. The general knowledge regarding fertility section encompassed two questions targeting the infertility definition [“A couple is considered to have infertility when, after one year of regular sexual intercourse (without using contraception), pregnancy does not occur.”], and infertility prevalence (“About 1 in 10 couples have an infertility problem”). These two questions were formulated based on the ones in the Stevenson et al. [8] study and were answered in a True/False format. Two multiple-choice questions tackling women’s fertile age (“At what age are women considered most fertile?”) [8] and “IVF success rates (“After an In Vitro Fertilization (IVF) treatment, the probability of pregnancy is...”), based on several other studies [14, 15,17], were also included.

The knowledge about factors affecting fertility section comprised one multiple-choice question related to women’s fertility decline with age (“In what age range does a woman's chance of becoming pregnant decrease most markedly?”; with six options) [17] and six other questions addressing men’s age affecting fertility (“The age of the man is a factor that affects fertility”; specifically defined for the current study) and lifestyle factors (low weight, overweight/obesity, smoking, alcohol consumption and sexually transmitted infections) [4]. The fertility preservation knowledge section encompassed three questions (“Are you aware of any of the following fertility preservation options? - Oocyte cryopreservation, Cryopreservation of embryos; Ovarian tissue cryopreservation) [4]. These were answered using the following options: “I have a lot of knowledge”, “I have little knowledge, I only hear about it”, and “I have no knowledge”. Another group of questions within this section intended to address the groups of people to whom fertility preservation may be indicated (e.g., “Women who have not yet planned pregnancy and who may be less likely to become pregnant later due to age”; “Men and women, before surgery that may compromise reproductive capacity”) [15].

These questions were answered True/False/Don’t know. The last question in this section, also adapted from [15] was “Is oocyte cryopreservation a procedure used in Portugal?”, was answered in a True/False/Don’t know format. The attitudes towards fertility preservation section included seven statements [14] using the following prompt: “In your opinion, the provision of information about fertility preservation:” (e.g., “Should be part of regular health care, being provided by the doctor to women of childbearing age”, “Should be discussed when requested by the patient”). The participants were asked to rate their level of agreement with each sentence using a 5-point scale ranging from completely agree to completely disagree. The desire for information in fertility preservation section included one question (“Would you be willing to receive more education on fertility preservation options?”), answered Yes/No/Don’t know [15].

The research team translated the questions into Portuguese, and the original and translated versions were checked by a native speaker acting as an English teacher in a language school. A group of five graduated students were asked to give feedback on the questions' comprehensibility. These students reported no difficulties in understanding the instructions and the questions.”

Data analysis

The data analyses were computed using SPSS (v.28). The sample characteristics were described using means and standard deviations for continuous variables and frequencies and percentages for categorical variables. Frequencies and percentages were also calculated for the questionnaire answers. Differences between professionals and students regarding the study variables were examined through chi-squared tests. Statistical significance was established at $p < 0.05$.

Ethical aspects

The Ethics Committee of the Instituto Superior Miguel Torga approved the study (ref. CE-P03-22). The study was conducted in accordance with the principles of the 1983 Declaration of Helsinki, as revised in 2013. The inclusion criteria were being a health professional or student in medicine, nursing, or psychology, given that these are the health areas more related to fertility. An online advertisement on several social media platforms and private messages were used to recruit participants. Each participant was asked to share the study link with two more health professionals (medical doctors, nurses, or psychologists) or students attending medical, nursing, or psychology faculties (Exponential Non-Discriminative Snowball Sampling method). This sampling procedure is cost- and time-efficient, reducing the need for extensive outreach efforts and revealing an effective way to recruit study participants [19]. Information regarding the study's aims and procedures, inclusion criteria, and voluntary participation was provided before accessing the link to the online research protocol available through the Google Forms platform. Participants provided their informed consent before completing the survey. Data collection took place between March and May 2022.

RESULTS

General knowledge regarding fertility

Results regarding general fertility knowledge in students and professionals are presented in Table 1.

Table 1. General knowledge regarding fertility in students and professionals ($n = 309$).

	Students		Professionals	
	True	False	True	False
A couple is considered to have infertility when, after one year of regular sexual intercourse (without using contraception), pregnancy does not occur.	132(61.7%)	82(38.3%)	72(75.8%)	23(24.2%)
About 1 in 10 couples have an infertility problem.	182(85%)	32(15%)	76(80%)	19(20%)

At what age are women considered most fertile?	Before 20 years old	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49
Students	21(9.8%)	119(55.6%)	66(30.8%)	6(2.8%)	0(0%)	0(0%)	2(0.9%)
Professionals	8(8.4%)	60(63.2%)	24(25.3%)	3(3.2%)	0(0%)	0(0%)	0(0%)
After an <i>In Vitro</i> Fertilization (IVF) treatment, the probability of pregnancy is:	<15%	16 - 25%	26-35%	36-45%	>45%	-	-
Students	24(11.2%)	58(27.1%)	61(28.5%)	46(21.5%)	25(11.7%)	-	-
Professionals	9(9.5%)	25(26.3%)	37(38.9%)	12(12.6%)	12(12.6%)	-	-

Note: Correct answers are in bold.

Regarding the definition of infertility, the majority of participants, including students and healthcare professionals, provided a correct answer (True). Nevertheless, 38.3% of students and 24.2% of professionals still seemed not to be familiar with this definition. A similar pattern was found for the question addressing infertility prevalence, with 15% of the students and 20% of the professionals giving the wrong answer (False). Concerning the age at which a woman is considered most fertile, the majority of students ($n = 119$; 55.6%) responded that it was between 20 and 24 years old, leading to 96 incorrect answers (43.4%). Sixty professionals (63.2%) gave the correct answer. Regarding the question “After an *In Vitro* Fertilization (IVF) treatment, the probability of pregnancy is:” 61 students (28.5%) and 37 professionals (38.9) answered correctly (26 - 35%).

Knowledge about factors affecting fertility

Participants were asked to answer a multiple-choice question capturing knowledge concerning women’s age and fertility decline and six True/False questions addressing men’s age, weight, smoking, alcohol, and sexually transmitted infections. Results are presented in Table 2.

Eighty-one students (37.9%) identified the age range 35-39 as the one in which a woman's chance of becoming pregnant decreases most markedly, meaning that the majority ($n = 133$; 62%) answered incorrectly. Professional’s results revealed a similar pattern, with 62(65.3%) answering the incorrect age intervals. Although most of the students and professionals knew that the male partner's age affected fertility, 89 (41.6%) students and 36 (37.9%) professionals answered it was false. Regarding the aspects contributing to the decrease in fertility, most participants (students and healthcare professionals) responded positively to all the topics presented.

Table 2. Knowledge about factors affecting fertility.

In what age range does a woman's chance of becoming pregnant decrease most markedly?	20 - 24	25 - 29	30 – 34	35 - 39	40 – 44	45 - 49
Students	2(0.9%)	2(0.9%)	12(5.6%)	81(37.9)	54(25.2%)	63(29.4%)
Professionals	0(0%)	2(2.1%)	3(3.2%)	33(34.7%)	24(25.3%)	33(34.7%)
	Students			Professionals		
	True		False	True		False
The age of the man is a factor that affects fertility.	125(58.4%)		89(41.6%)	59(62.1%)		36(37.9%)
The following contribute to decreasing fertility:						
Low weight	170(79.4%)		44(20.6%)	80(84.2%)		15(15.8%)
Overweight/obesity	182(85%)		32(15%)	86(90.5%)		9(9.5%)
Smoking	200(93.5%)		14(6.5%)	88(92.6%)		7(7.4%)
Alcohol Consumption	193(90.2%)		21(9.8%)	88(92.6%)		7(7.4%)
Sexually transmitted infections	160(74.8%)		54(25.2%)	82(86.3%)		13(13.7%)

Note: Correct answers are in bold.

Fertility preservation knowledge

Results regarding fertility preservation knowledge are presented in Table 3. Most participants stated that they had little knowledge or only had heard about oocyte cryopreservation (Students $n = 154$, 72%; Professionals $n = 53$, 55.8%), cryopreservation of embryos (Students: $n = 155$, 72.4%; Professionals $n = 56$, 58.9%), and ovarian tissue cryopreservation (Students: $n = 103$, 48.1%; Professionals $n = 42$, 44.2%). For this last fertility preservation option, 46(48.4%) professionals mentioned having no knowledge.

Table 3. Fertility preservation knowledge in students and professionals.

	Students			Professionals		
	I have a lot of knowledge	I have little knowledge; I only heard about it	I have no knowledge	I have a lot of knowledge	I have little knowledge; I only heard about it	I have no knowledge
Are you aware of any of the following fertility preservation options?						
Oocyte cryopreservation: oocytes are extracted, cryopreserved, and stored for later use	46(21.5%)	154(72%)	14(6.5%)	34(35.8%)	53(55.8%)	8(8.4%)
Cryopreservation of embryos: After the oocytes are extracted, they are fertilized with sperm from the partner or donor, and the embryos are cryopreserved for later use	36(16.8%)	155(72.4%)	23(10.7%)	25(26.3%)	56(58.9%)	14(14.7%)
Ovarian tissue cryopreservation: surgery performed to obtain a portion of ovarian tissue, which is then cryopreserved, stored, and later thawed and grafted onto the remaining ovary or to another location	17(7.9%)	103(48.1%)	94(43.9%)	7(7.4%)	42(44.2%)	46(48.4%)

In which of the following groups of people is fertility preservation indicated?			Don't know/Unsure		Don't know/Unsure	
	True	False	True	False	True	False
Women who have not yet planned pregnancy and who may be less likely to become pregnant later due to age ("social" cryopreservation, i.e., for non-medical reasons)	178(83.2%)	7(3.3%)	29(13.6%)	76(80%)	6(6.3%)	13(13.7%)
Women with a low ovarian reserve and a family history of early menopause	178(83.2%)	7(3.3%)	29(13.6%)	80(84.2%)	4(4.2%)	11(11.6%)
Women with a low ovarian reserve who have never been mothers	130(60.7%)	27(12.6%)	57(26.6%)	53(55.8%)	23(24.2%)	19(20%)
Men and women, before surgery that may compromise reproductive capacity	166(79.4%)	10(4.7%)	38(17.8%)	81(85.3%)	4(4.2%)	10(10.5%)
Women of reproductive age requiring potentially gonadotoxic treatments such as chemotherapy and radiation therapy	170(79.4%)	17(7.9%)	42(19.6%)	91(95.8%)	1(1.1%)	3(3.2%)
Men of reproductive age requiring potentially gonadotoxic treatments such as chemotherapy and radiation therapy	155(72.4%)	17(7.9%)	42(19.6%)	88(92.6%)	2(2.1%)	5(5.3%)
Is oocyte cryopreservation a procedure used in Portugal?			Don't know/Unsure		Don't know/Unsure	
	131(61.2%)	8(3.7%)	75(35%)	71(74.7%)	5(5.3%)	19(20%)

Concerning the questions addressing groups of people for whom fertility preservation might be indicated, most participants (students and professionals) identified correct answers in all options, with the "don't know/unsure" option being the second most frequently marked. The majority of the students ($n = 131$; 61.2%) and professionals ($n = 71$; 74.7%) acknowledged that oocyte cryopreservation

is a procedure used in Portugal, but there were still 38.7% of students and 25.3% of professionals who did not know the answer.

Attitudes toward fertility preservation

Results regarding attitudes toward fertility preservation are presented in Table 4.

Table 4. Attitudes towards fertility preservation.

In your opinion, the provision of information about fertility preservation:	Completely agree	Agree	Neither agree nor disagree	Disagree	Completely disagree
Should be part of regular health care being provided by the doctor to women of childbearing age					
Students	144(67.3%)	61(28.5%)	6(2.8%)	3(1.4%)	0(0%)
Professionals	65(68.4%)	22(23.2%)	4(4.2%)	3(3.2%)	1(1.1%)
Allows educating women about this issue, helping them to make more reproductive health-informed decisions					
Students	175(81.8%)	34(15.9%)	5(2.3%)	0(0%)	0(0%)
Professionals	69(72.6%)	21(22.1%)	4(4.2%)	0(0%)	1(1.1%)
Clarifies the implications of oocyte cryopreservation by increasing knowledge about it					
Students	151(70.6%)	48(22.4%)	13(6.1%)	2(0.9%)	0(0%)
Professionals	67(70.5%)	23(24.2%)	4(4.2%)	0(0%)	1(1.1%)
Provides education about overall health					
Students	149(69.6%)	50(23.4%)	10(4.7%)	4(1.9%)	1(0.5%)
Professionals	61(64.2%)	27(28.4%)	4(4.2%)	2(2.1%)	1(1.1%)
It may be seen as intrusive and inappropriate					
Students	7(3.3%)	20(9.3%)	42(19.6%)	67(31.3%)	78(36.4%)
Professionals	3(3.2%)	13(13.7%)	15(15.8%)	31(32.6%)	33(34.7%)
Should be discussed only when requested by the patient					

Students	11(5.1%)	36(16.8%)	58(27.1%)	83(38.8%)	26(12.1%)
Professionals	7(7.4%)	19(20%)	21(22.1%)	40(42.1%)	8(8.4%)
Should only be addressed when there are medical reasons for doing so					
Students	8(3.7%)	31(14.5%)	60(28%)	71(33.2%)	44(20.6%)
Professionals	8(8.4%)	16(16.8%)	17(17.9%)	38(40%)	16(16.8%)

To further capture the participants' opinions towards the provision of fertility preservation information, they were asked to score the extent to which they agreed with seven items. One hundred forty-four students (67.3%) and 65 professionals (68.4%) agree that fertility preservation information should be part of regular health care provided by the doctor to women of childbearing age. One hundred seventy-five students (81.8%) and 69 professionals (72.6%) completely agreed that providing fertility information allows educating women about this issue and helps them make more reproductive health-informed decisions. One hundred fifty-one students (70.6%) and 67 professionals (70.5%) completely agreed that it clarifies the implications of oocyte cryopreservation by increasing knowledge about different reproductive choices. One hundred forty-nine students (69.6%) and 61 professionals (64.2%) completely agree that it provides education about global health. On the other hand, only seven students (3.3%) and 3 professionals (3.2%) completely agree that providing information about fertility preservation can be seen as intrusive and inappropriate. One hundred and nine students (50.9%) and 48 professionals (50.5%) disagree or completely disagree that discussing fertility preservation should only occur when the patient requests. Finally, one hundred and fifteen students (53.8%) and 54 professionals (56.8%) disagree or completely disagree that fertility information should only be addressed for medical reasons.

The desire for information on the topic of fertility preservation

Results regarding the desire for information on fertility preservation revealed that most students ($n = 192$; 89.7%) and professionals ($n = 71$; 74.7%) expressed being willing to receive training regarding fertility preservation. Ten students (4.7%) and 15 professionals (15.8%) were unsure. Finally, 12 (5.6%) students and nine (9.5%) professionals considered not needing training on the topic of fertility preservation.

Differences between health professionals and students

Chi-squared tests were conducted to explore differences between professionals and students regarding variables with correct/wrong answers. The results showed no significant differences between these two groups ($p > .050$) in the majority of the questions except for "A couple is considered to have infertility when, after one year of regular sexual intercourse (without using contraception), a pregnancy does not occur" [$\chi^2_{(1,309)} = 5.84$; $p = .016$; OR = .54; CI_{95%} = .30 to .89], "The following contribute to decreased fertility: [Sexually transmitted infections]" [$\chi^2_{(1,309)} = 5.17$; $p = .023$; OR = .47; CI_{95%} = .24 to .91], "In which of the following groups of people is fertility preservation indicated? [Women of reproductive age requiring potentially gonadotoxic treatments such as chemotherapy and radiation therapy]" [$\chi^2_{(1,309)} = 13.41$; $p < .001$] and "Is oocyte cryopreservation a procedure used in our

country?" [$\chi^2_{(1,309)} = 5.31; p = .021$]. As expected, professionals reported a higher percentage of correct answers when compared to students.

Concerning the level of agreement with the statements addressing attitudes towards the provision of fertility preservation information, no significant differences were found between students and healthcare professionals ($p > .050$), except for the question "Would you be willing to receive more education on fertility preservation options?", with more students stating they would like to receive training on this topic.

DISCUSSION

This study aimed to examine perceptions of general knowledge regarding fertility and factors affecting fertility, fertility preservation knowledge, attitudes towards fertility preservation, and the extent to which health professionals and students would be interested in accessing more information concerning fertility preservation. Furthermore, it sought to explore whether there were differences between professionals and students regarding these topics.

Although the majority of students and healthcare providers in the current sample were aware of the definition of infertility, 38.3% of students and 24.2% of professionals still answered incorrectly to this question. Regarding infertility prevalence, 85% of the students and 80% of the professionals were aware of the correct prevalence. Students (55.6%) and professionals (63.2%) were aware of the age at which women are more fertile. This is in line with a review that found results from studies stating that the most fertile age for women to be at 20–24 ranged from 16% to 89.4% [18]. Concerning the IVF success rates, it was possible to identify that 38.3% of students and 35.8% of professionals underestimated the IVF success rates, whereas 33.2% and 27.8%, respectively, overestimated these rates. Interestingly, previous studies reported that Ob/Gyn physicians [9] and Ob/Gyn residents [14] overestimated the likelihood of success using ART.

When considering the age when there is a significant fertility decline, more than half of the students (54.6%) and the professionals (60%) overestimated the age of women. When considering the male partner's age as a factor affecting fertility, 41.6% of the students and 37.9% of the professionals answered incorrectly, suggesting that students and healthcare professionals are not sufficiently aware of the potential consequences of men's age on fertility. Similar results were found in other studies [9, 18], pointing to the need to increase the knowledge of health professionals and the general public regarding age-related fertility decline. In line with this, Mahesan, Sadek, and Ramadan (2019) also found a demand for training in undergraduates and medical students regarding age-related changes in fertility due to students' tendency to overestimate the age of fertility decay [13]. This is particularly relevant given that age is a relevant determinant of infertility (e.g., reduced ovarian reserve). Moreover, IVF success rates are also age-dependent, and fetal adverse events increase with rising age [20,21]. Regarding lifestyle factors affecting fertility, health professionals and students were well aware that factors such as weight, alcohol, smoking, and sexually transmitted infections impact fertility. The listed factors have been well established as interrelated lifestyle factors with the potential to impact reproductive health [22]; therefore, it was somehow expected that professionals and students would recognize these as risk factors for fertility.

Concerning fertility preservation, the students' and professionals' answers revealed that oocyte cryopreservation was the option they knew best, followed by embryo cryopreservation and ovarian tissue cryopreservation. Nevertheless, participants stated that they had little knowledge or only heard about it, and 43.9% of students and 48.4% of professionals mentioned that they did not know

about ovarian tissue cryopreservation. These results are similar to other studies showing that GPs have partial awareness of oocyte cryopreservation [15]. Considering the groups of people to whom fertility preservation may be directed, most participants were aware of medical and non-medical reasons. In the current study, students and professionals were more in favor of fertility preservation for non-medical reasons. This is relevant information, given that providing efficient counselling for women pondering oocyte freezing for non-medical reasons may positively impact the threat of future involuntary childlessness [23]. In contrast, almost half of the GPs in the Demir et al. (2020) study considered that oocyte cryopreservation was inappropriate for women who have not yet planned pregnancy and are unlikely to become pregnant later due to age [15]. Another study also found that residents were less prone to support elective oocyte cryopreservation than oocyte cryopreservation in cancer patients [14]. In the current sample, the majority of students (61.2%) and professionals (74.7%) knew that oocyte cryopreservation is used in Portugal. Still, 35% of students and 2% of professionals needed clarification on it.

Health professionals and students mostly fully agreed or agreed that providing information about fertility preservation should be part of regular healthcare, be provided by the doctor to women of childbearing age, allowing them to make more reproductive health-informed decisions, clarifying the implications of oocyte cryopreservation by increasing knowledge about it, and providing education about overall health. On the contrary, they disagreed or completely disagreed that the provision of information about fertility preservation may be seen as intrusive and inappropriate, should be discussed only when requested by the patient, and should only be addressed when there are medical reasons for doing so. Participants' attitudes toward delivering information about fertility preservation were generally favorable. Considering that health literacy can be defined as the 'ability of an individual to obtain and translate knowledge and information in order to maintain and improve health in a way that is appropriate to the individual and system contexts' [24], the participants' attitudes seem aligned with the idea of contributing to patients' health literacy. Furthermore, 89.7% of the students and 74.7% of the professionals mentioned that it would be helpful for their professional practice to receive training on fertility preservation.

When comparing health professionals and students, as expected, professionals revealed more correct answers regarding the infertility definition and the recognition that sexually transmitted infections may affect fertility. Moreover, professionals also provided more correct answers concerning the identification of women of reproductive age requiring potentially gonadotoxic treatments, a target group for fertility preservation, and the knowledge that oocyte cryopreservation is a technique performed in Portugal. One may hypothesize that they have more contact with these topics due to their practice and more years of training, in contrast to the students continuing their training.

Study limitations

The present study findings must be interpreted considering some limitations. The small number of responses from health professionals and postgraduate students in fields directly related to fertility and its preservation (e.g., gynecologists) does not allow for assessing these professionals' fertility knowledge. Therefore, future studies should also be conducted on specialists and Ob/Gyn residents. In the student and professional groups, the participants were predominantly women. This limitation may impact the results and has been reported in other fertility studies [e.g., 25, 26]. The current sample was a convenience sample, and the snowball recruitment procedure encompasses the

limitations of the potential for sampling bias and the lack of generalizability to the broader population. Nevertheless, data were collected online and anonymously, and anonymity prevented sample bias due to the possible social desirability among participants. Moreover, although the questions were extracted from previous studies, every question was not externally validated.

CONCLUSION

Despite having some information, professionals and students still need more knowledge to support their patients. It may be hypothesized that the inclusion of fertility and fertility preservation content in undergraduate and graduate curricula and continuing professional training is insufficient, and there is room for improvement. Given that students and professionals were receptive to fertility educational intervention, future research could address various methods of disseminating information to define more efficacious ones.

These results highlight the relevance of designing training and information opportunities to enhance health professionals' and students' knowledge of fertility awareness, specifically on fertility preservation, which will enable them to attend to their patients' needs and preferences. Providing students and professionals with fertility-focused education and resources may improve reproductive outcomes by allowing them to counsel their patients more precisely and promptly.

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