

The role of knowledge and perceived susceptibility in intentions to optimize fertility: findings from the International Fertility Decision-Making Study (IFDMS)

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Submitted on May 9, 2013; resubmitted on August 21, 2013; accepted on August 22, 2013

STUDY QUESTION: What is the role of knowledge, perceived vulnerability and level of risk of infertility in women's intentions to take action to improve their chance of becoming pregnant (i.e. by seeking medical and/or non-medical help and making lifestyle changes)?

SUMMARY ANSWER: Women younger than age 35 were more likely to intend to take measures to improve their chance of conceiving when they were knowledgeable about fertility and felt susceptible to infertility; however, there was no such association in older women.

WHAT IS KNOWN ALREADY: The majority of young adults wish to become parents but many are jeopardizing their chances by engaging in behaviours that decrease fertility (e.g. smoking, not seeking timely medical advice when faced with problems conceiving). Research is needed to establish what motivates people to take steps to optimize their chances of pregnancy. The Health Belief Model (HBM) postulates that knowledge and beliefs about susceptibility to infertility are critical in whether people will engage in fertility-optimizing behaviours.

STUDY DESIGN, SIZE AND DURATION: This cross-sectional survey included 1345 childless women (trying to conceive and having never engaged in fertility medical treatment) from the International Fertility Decision-Making Study (IFDMS).

PARTICIPANTS/MATERIALS, SETTING, METHODS: Infertility risk factors were determined using the FertiSTAT. The Cardiff Fertility Knowledge Scale (CFKS) assessed fertility knowledge. Perceived susceptibility was defined as whether a fertility problem was suspected. The outcome measure was intentions to optimize one's fertility by making lifestyle changes and/or seeking help.

MAIN RESULTS AND THE ROLE OF CHANCE: In this study, 75.5% of women had an infertility risk factor and 60.3% suspected a fertility problem. The average correct score on the CFKS was 51.9%. Intentions to optimize fertility were lower among women who were heavy smokers ($P < 0.05$) and who had been trying to conceive for a year or over ($P < 0.01$), while intentions to optimize fertility were greater among those with a higher body mass index or greater knowledge and those who suspected a fertility problem (all $P < 0.001$). These overall effects were qualified in some subgroups. Heavy smokers were more likely to intend to seek medical help when they had greater knowledge ($P < 0.001$) and women having difficulty conceiving were more likely to intend to seek medical help if they felt susceptible to infertility ($P < 0.001$). Heavy smokers who were knowledgeable intended to change their lifestyle only when they felt they had a fertility problem ($P < 0.01$). Intentions to change were not dependent on knowledge and perceived susceptibility in older women.

LIMITATIONS, REASONS FOR CAUTION: The data were cross-sectional and thus we cannot infer causality. The results may have been affected by the sample profile, which was biased towards high levels of perceived susceptibility and low levels of knowledge.

WIDER IMPLICATIONS OF THE FINDINGS: To maximize impact, educational campaigns should take into account the presence and type of infertility risk factors in the target audience.

STUDY FUNDING/COMPETING INTERESTS: Merck-Serono S. A. Geneva-Switzerland (an affiliate of Merck KGaA Darmstadt, Germany) and the Economic and Social Research Council (ESRC, UK) funded this project (RES-355-25-0038, 'Fertility Pathways Network'). L.B. is funded by a postdoctoral fellowship from the Medical Research Council (MRC) and the ESRC (PTA-037-27-0192). B.F. is funded by an interdisciplinary PhD studentship from the ESRC/MRC (ES/1031790/1). I.T. is an employee of Merck-Serono S.A. Geneva-Switzerland (an affiliate of Merck KGaA Darmstadt, Germany).

Key words: fertility / knowledge / perceived susceptibility / intentions / IFDMS

Introduction

Infertility is defined as the inability to conceive after 12 months or more of regular unprotected intercourse (Zegers-Hochschild et al., 2009). An estimated 9% of people worldwide are infertile (Boivin et al., 2007). There are measures an individual can take to optimize their fertility, which means to reduce the risk of infertility and increase the chance of becoming pregnant. Measures to optimize fertility include adopting healthier lifestyles and seeking timely medical and non-medical help (National Institute of Health and Clinical Excellence (NICE), 2013). However, despite the fact that the vast majority of people want to eventually be parents (93–97% of individuals; Berrington, 2004; Lampic et al., 2006; Testa, 2007) many people fail to optimize their chance of having children. For example, rates of obesity in the UK have increased to 60% in men and 52% in women (Office for National Statistics (ONS), 2011a) and 22% of men and 20% of women smoke (Office for National Statistics (ONS), 2011a). In addition, people are delaying childbearing to older ages. There has been an almost 3-fold increase between 1990 and 2010 in the number of women giving birth at age 40 or over (Office for National Statistics (ONS), 2011b), by which time pregnancy-related health complications are more likely (Utting and Bewley, 2011). The impact of childbearing postponement is reflected in an increase in the number of older women seeking fertility treatment (de Graaff et al., 2011). However, fertility help-seeking is generally poor; only 56% of couples consult a doctor when they have problems conceiving (Boivin et al., 2007) and 20% delay seeking that help for >2 years (Bunting and Boivin, 2007). The present study therefore aimed to find out when people become willing to take measures to optimize their fertility.

The negative effects on natural and medically assisted pregnancy rates associated with failure to change unhealthy lifestyle habits and/or engage in timely fertility help-seeking are well documented (Templeton et al., 1996; Lintsen et al., 2005; Maheshwari et al., 2007; Bunting and Boivin, 2010). According to the Health Belief Model (HBM), to understand why people fail to take measures to improve their chance of pregnancy, it is necessary to consider how much they know about fertility (Rosenstock, 1990; Stretcher and Rosenstock, 1997). People have relatively poor knowledge about fertility and this may delay those with one or more infertility risk factors from identifying that they are at risk, which is a necessary step in help-seeking (Rosenstock, 1990; White et al., 2006). For example, people on average answer correctly only 53% of questions about fertility facts, risks and myths (Bunting and Boivin, 2008). Further, <50% of people correctly identify age as the strongest risk factor for female infertility (Bretherick et al., 2010).

The HBM argues that people also need to feel susceptible to a health risk in order to make efforts to reduce that risk (Rosenstock, 1990). How susceptible an individual feels to a health risk (in this case, reduced chance of pregnancy) refers to how likely they believe it is that they could have

the health risk (Rosenstock, 1990). An individual is unlikely to take measures to optimize their fertility if they do not feel susceptible to reduced chance of pregnancy (Rosenstock, 1990). This is indeed the case in other health contexts; for example, women who do not feel susceptible to cancer are less likely to undergo cancer screening (Kim et al., 2008). The HBM would predict that fertility knowledge and perceived susceptibility are independently and jointly associated with intention to optimize fertility, such as seeking medical advice or making lifestyle adjustments.

The aim of the present study was to investigate whether knowledge, perceived susceptibility and infertility risk status relate to intentions to optimize fertility. Participants were women who were trying to get pregnant and had not sought any medical help regarding their fertility. Participants were drawn from the International Fertility Decision-Making Study (IFDMS; Bunting et al., 2013). It was hypothesized that having fertility knowledge and feeling susceptible to infertility would be associated with heightened intentions to optimize fertility and furthermore that this association would be stronger among women with at least one infertility risk factor.

Materials and Methods

Participants

Recruitment for the IFDMS was via three sources. The first source was online advertising [search engines (Google); social media websites (Facebook) and websites targeted at people trying to conceive (e.g. Babycentre, patient advocacy sites, fertility clinics)]. The second source was market research companies [in four countries where online recruitment was limited: Japan, Russia and India (Ipsos-Health) and China (IMS-Health)]. The third source was fertility clinics (in two countries where online recruitment was limited: China and India). Patients using specialist fertility medical services [e.g. preimplantation genetic diagnosis, treatment for human immunodeficiency virus (HIV) seropositive or HIV discordant or hepatitis C] were excluded from recruitment in fertility clinics. All other people attending fertility clinics were eligible whether it was for fertility-related or other reasons (e.g. smear tests, gynaecological reasons). Inclusion criteria were that respondents were aged between 18 and 50, currently married or living with their partner, currently having tried to conceive for at least 6 months and not pregnant. The IFDMS survey generated a total of 10 045 respondents (8355 women and 1690 men) from 79 countries. Full details of the study and its cohort profile are published elsewhere (Bunting et al., 2013).

In the present study, the following inclusion criteria were additionally applied: (i) female respondent (ii) aged below 45 years, i.e. within the child-bearing age range (iii) never given birth and (iv) never having sought medical consultation regarding trying to conceive. The final sample consisted of 1345 women from 38 countries. The majority of participants ($n = 1199$, 89.1%) were recruited via online advertising, while 130 (9.7%) were recruited from the social research panel and 16 (1.2%) were recruited from fertility clinics. On average participants were 28.5 years old ($SD = 5.6$), had been

living with their partner for 3.8 years ($SD = 3$) and had been trying to conceive for 1.5 years ($SD = 1.9$). Within the sample, 534 (39.7%) women had tried lifestyle change and 709 (52.7%) had sought non-medical help (e.g. advice from friends or books, acupuncture) as a means of improving their fertility.

Questionnaire design

Psychological theories (e.g. theory of planned behaviour, Azjen, 1991; HBM, Rosenstock, 1990) and a systematic review of published literature regarding reproductive decision-making informed the selection of survey items. Survey wording was adapted to be appropriate to men and women and to people who had/had not sought fertility treatment. The final survey consisted of 64 items covering five broad domains of decision-making. Only items relevant to analyses presented in this paper are described (for the full survey see www.startingfamilies.org).

Infertility risk factors

The four infertility risk factors included were: body mass index (BMI) [weight in kilograms divided by height in metres squared (kg/m^2)]; number of cigarettes smoked per day (among participants who indicated that they smoked); age; and length of time trying to conceive (number of years and months spent trying to get pregnant). Participants were considered to be at risk of infertility if their score on one or more of the risk factors was above the critical thresholds used in the Fertility Status Awareness Tool (FertiSTAT; Bunting and Boivin, 2010); specifically, if their BMI was 25 or over, if they smoked 10 or more cigarettes per day, were aged over 34 or had been trying to conceive for 12 months or more.

Fertility knowledge

The Cardiff Fertility Knowledge Scale (CFKS; see Bunting et al., 2013) assessed fertility knowledge. The CFKS consists of 13 items, derived from previous research (Adashi et al., 2000; NICE, 2004; Lampic et al., 2006; Boivin et al., 2007; Tough et al., 2007; Zegers-Hochschild et al., 2009; Bunting and Boivin, 2010), that measure knowledge about fertility facts, risks and myths. Three items referred to facts (e.g. a woman is less fertile after the age of 36 years), five items referred to risks (e.g. smoking decreases female fertility) and five items referred to myths (e.g. if a man produces sperm, he is fertile). All items were rated on a three-point scale of 'true', 'false' or 'do not know'. Reliability of the items among the present sample was good; Cronbach alpha = 0.74 (for the total IFDMS sample of $n = 10045$, Cronbach alpha = 0.79). The items were combined into a composite correct variable, where one point was awarded for each correctly identified fact, risk or myth, with the total score ranging from 0 to 100% correct. The 'do not know' response was coded as incorrect.

Perceived susceptibility

Perceived susceptibility to infertility was measured using two items that asked participants whether they suspected that they/their partner had a fertility problem (yes/no).

Intention to optimize fertility

Intention to optimize fertility was conceptualized as the likelihood of seeking medical and non-medical help and making lifestyle changes to improve the chances of getting pregnant. Intention was measured using variables derived from previous research on help-seeking (e.g. Bunting and Boivin, 2007). Specifically, the likelihood of medical help-seeking was assessed using 10 items referring to seeking medical advice (e.g. from a medical doctor) and/or medical intervention (e.g. diagnostic tests or fertility medication) to increase the chance of conceiving. Likelihood of non-medical help-seeking was assessed via five items relating to non-medical advice (e.g. from friends or books) and non-medical interventions (e.g. acupuncture,

treatment from a traditional healer). Items were combined to form two composite variables measuring likelihood of trying medical options and likelihood of trying non-medical options. Reliability was satisfactory (Cronbach alpha = 0.91 for medical help-seeking items and 0.72 for non-medical help-seeking items). Intention to make lifestyle changes was measured using one item that asked participants to rate the likelihood that they would use 'lifestyle change (e.g. quit smoking, lose weight)'. Examples of target behaviours were provided within the wording of the item. Participants rated the likelihood that they would try each fertility-optimizing behaviour (i.e. medical help-seeking, non-medical help-seeking and lifestyle change) on a five-point scale ('not at all likely' to 'extremely likely').

Control variables

Education was categorized as whether or not the participant had a university education (yes/no). Economic hardship was assessed via two items in which participants indicated whether during the last 12 months they had had trouble paying bills and trouble buying essentials (e.g. food, clothes) on a five-point scale ('never' to 'very often', or 'do not know') adapted from McQuillan's economic hardship index (McQuillan et al., 2011). The items were combined to form a variable with scores of one to nine representing never to always experiencing economic hardship.

Procedure

The data collection period was from July 2009 to April 2010. We used multiple data collection methods (social research panel, fertility clinic or online) according to what was feasible in each target country. Social research companies, fertility clinics and webmasters distributed the IFDMS survey. For all online methods, a banner about the IFDMS (e.g. 'Trying to conceive? Contribute to a fertility survey from Cardiff University') and a study hyperlink were placed at an appropriate position on the website. The survey was produced in English and translated into 12 languages (see Bunting et al., 2013, for full procedural details). The IFDMS study received ethical review and approval from the ethics committee of the institution and from each clinic as per the requirements in that country.

Data analyses

Data screening showed that the variables were normally distributed and appropriate for intended analyses. Descriptive statistics were used to examine the socio-demographic and fertility profile of the sample. A repeated measures ANOVA to examine whether likelihood of engagement varied between the fertility-optimizing behaviours (medical and non-medical help-seeking, lifestyle change) was computed among participants with no prior engagement in any of these behaviours ($n = 337$). Hierarchical multiple regression analyses were computed for the three fertility-optimizing behavioural intentions as dependent variables among participants who had not already engaged in the behaviour. Owing to missing data, 1178 participants were included for the composite medical help-seeking intentions variable, 451 participants were included for the composite non-medical help-seeking intentions variable and 634 participants were included for the lifestyle change intentions variable. Education and economic hardship were controlled for because people with higher education level and socio-economic status are less likely to have infertility risk factors (e.g. smoking) and more likely to have a healthy lifestyle and seek advice from medical services for health check-ups (Ross and Wu, 1995). The regression analysis was the same for each dependent variable and was designed to achieve the two aims of the study. On the first step of the analysis, the control variables were entered (education level and economic hardship). On the second step, the main effects of the infertility risk factors, knowledge and perceived susceptibility were entered to examine whether these factors were independently related to fertility-optimizing behavioural intentions. The infertility risk factors were entered into the regression as four separate variables, coded

0 or 1 for absence or presence of risk (respectively): BMI risk factor, number of cigarettes smoked per day risk factor, age risk factor and length of time trying to conceive risk factor. On the third step, the two-way interactions were entered to examine whether the association between each of the infertility risk factors and intentions to engage in fertility-optimizing behaviours was moderated by knowledge and/or perceived susceptibility. On the fourth and final step of the analysis, the three-way interactions were entered to examine whether the association between the infertility risk factors and intentions to optimize fertility depended jointly on knowledge and perceived susceptibility. Interactions were created by taking the cross-product of the variables considered in the interaction, and interactions significant at the 0.05 probability level were investigated using simple slope analyses according to the method of Aiken and West (1991). All analyses were computed using the software Statistical Package for the Social Sciences.

Results

Demographic characteristics

Table I shows the demographic characteristics of the total sample that was used in the regression analysis for medical help-seeking intentions and separately for the subsamples used in the analyses for non-medical help-seeking intentions and lifestyle change intentions. The majority of participants were between 18 and 29 years old, had university-level education, paid work for both themselves and their partner and did not experience economic hardship.

Table I Means (standard deviations) or frequencies (n, %) of demographic variables among participants included in analyses for medical help-seeking, non-medical help-seeking and lifestyle change.

	Medical help-seeking analyses N = 1345	Non-medical help-seeking analyses N = 490	Lifestyle change analyses N = 721
Age (M, SD)	28.5 (5.6)	27.9 (5.8)	28.2 (5.7)
Years living with partner (M, SD)	3.8 (3)	3.5 (2.9)	3.6 (2.9)
University education (n, %)	686 (51.2)	241 (49.3)	355 (49.4)
Paid work (n, %)	988 (74.4)	341 (70.2)	511 (71.7)
Partner paid work (n, %)	1197 (90.2)	429 (88.6)	639 (89.9)
Economic hardship (M, SD)	2 (1.7)	2.1 (1.7)	2 (1.8)

Due to missing data N varies per variable: 1327–1341 (medical help-seeking intentions), 484–489 (non-medical help-seeking intentions), 711–720 (lifestyle change intentions).

Fertility context variables

The proportion of the total sample and subsamples scoring above and below the infertility risk factor thresholds, level of perceived susceptibility and knowledge are shown in Table II. The most prevalent infertility risk factors were time spent trying to get pregnant, with roughly half of the sample meeting the World Health Organization (WHO) criteria for infertility (i.e. having tried to conceive for 12 months or more; Zegers-Hochschild et al., 2009). Data on BMI showed that almost 40% of participants were overweight. Overall 15.4% of the sample was older than 34 years and 14.6% smoked 10 or more cigarettes per day (26.6% of the sample smoked any number of cigarettes per day). In the total sample, 60.3% of participants suspected that either they or their partner had a fertility problem (of those who suspected a problem: 52.1% self, 10.7% partner, 37.2% both). Mean scores on the CFKS showed that on average 51.9% of fertility knowledge questions were answered correctly (SD = 22.9).

Intention to optimize fertility

A repeated measure ANOVA was computed to examine whether the likelihood of trying differed among the fertility-optimizing behaviours in participants with no prior engagement in any of these behaviours ($n = 333$). The analysis was significant, $F(2, 664) = 61.927, P < 0.001$. *Post hoc* tests using the Bonferroni correction revealed that participants who had not tried any fertility-optimizing behaviours were more likely to intend to try lifestyle change than medical ($P < 0.01$) or non-medical help-seeking ($P < 0.001$), with intention to seek medical help being significantly higher than non-medical help ($P < 0.001$). Participants who had already tried to make lifestyle changes ($n = 143$) were most likely to want to use medical help-seeking as their next means of improving their chance of pregnancy ($F(1, 142) = 68.909, P < 0.001$). In contrast, those who had only previously tried non-medical options ($n = 303$) indicated no preference for which fertility-optimizing behaviour they would try next ($F(1, 302) = 1.66, P = 0.199$).

Direct associations between infertility risk status, fertility knowledge, perceived susceptibility and intention to optimize fertility

After education level and economic hardship were controlled, infertility risk, knowledge and perceived susceptibility predicted medical help-seeking intentions ($F(8, 1170) = 12.999, P < 0.001$, mean square error (MSE) = 0.891), accounting for 8.2% of the variance. The main effects showed that women who smoked 10 or more cigarettes per day and women who had been trying to conceive for 12 months or more had lower intentions to seek medical help ($\beta = -0.058, P < 0.05$ and $\beta = -0.076, P < 0.01$, respectively). Intentions to seek medical help were stronger when fertility knowledge was high ($\beta = 0.190, P < 0.001$) and when a fertility problem was suspected ($\beta = 0.15, P < 0.001$). The semi-partial correlation coefficients indicated that knowledge and perceived susceptibility were the strongest predictors of medical help-seeking intentions, explaining 3.3 and 2.1% of the variance, respectively.

With the same control and predictor variables, the regression on lifestyle change intentions was also significant ($F(8, 626) = 5.31, P < 0.001$,

Table II Means (standard deviations) and frequencies (n, %) of fertility context variables among participants included in analyses for medical help-seeking, non-medical help-seeking and lifestyle change.

Risk factor thresholds	Medical help-seeking analyses				Non-medical help-seeking analyses				Lifestyle change analyses			
	N = 1345				N = 490				N = 721			
	n	%	M	SD	n	%	M	SD	n	%	M	SD
BMI												
< 25	803	61.6	21.2	2.2	304	62	20.8	2.4	455	63.1	21	2.3
≥ 25 (Risk)	500	38.4	30.8	6.2	174	35.5	30.8	5.4	244	34.8	30.9	6.6
Cigarettes smoked per day												
< 10 ^a	1112	85.4	4.5	2.4	383	78.2	4.1	2.3	572	79.3	4.4	2.4
≥ 10 (risk)	190	14.6	15.8	6	100	20.4	15.6	5.9	130	18	15.2	5.4
Age in years												
≤ 34	1135	84.6	26.8	4.2	419	85.5	26.2	4.2	610	84.6	26.5	4.2
> 34 (risk)	206	15.4	37.8	2.5	70	14.3	38.1	2.6	110	15.3	37.8	2.4
Months trying to conceive												
< 12	645	48.2	6.6	2.2	235	48	6.1	2.3	357	49.5	6.4	2.2
≥ 12 (risk)	692	51.8	29.1	28.3	254	51.8	27.7	26.9	359	49.8	29.5	29.2
Perceived susceptibility	798	60.3	–	–	273	56.9	–	–	413	57.8	–	–
Cardiff Fertility Knowledge Scale (CFKS)	–	–	51.9	22.9	–	–	45.6	23.2	–	–	50.1	23.2

Due to missing data *N* varies per variable, 1302–1341 (medical help-seeking intentions), 478–489 (non-medical help-seeking intentions), 699–720 (lifestyle change intentions). BMI, body mass index. Perceived susceptibility refers to whether participants suspected that they or their partner had a fertility problem (yes/no). CFKS fertility knowledge 0–100%.

^aSmoke < 10 cigarettes per day includes non-smokers: *n* = 971 (73.4%) medical help-seeking intentions, *n* = 336 (69.1%) non-medical help-seeking intentions, *n* = 497 (70.2%) lifestyle change intentions.

MSE = 1.876), accounting for 6.4% of the variance. Women with a BMI of 25 or over and those with greater fertility knowledge had higher intentions to change their lifestyle ($\beta = 0.142$, $P < 0.001$; $\beta = 0.1$, $P < 0.05$, respectively). The semi-partial correlations showed that BMI was the strongest predictor of lifestyle change intentions, explaining 1.9% of the variance.

The regression model for non-medical help-seeking intentions was non-significant ($P = \text{n.s.}$), showing that none of the variables selected could explain these intentions (see Table III for the regression summary analyses).

Moderation among infertility risk status, fertility knowledge, perceived susceptibility and intention to optimize fertility

The predictive power for medical help-seeking intentions was significantly improved by adding two-way interaction terms to the regression model ($F(17, 1161) = 7.058$, $P < 0.001$, $\text{MSE} = 0.874$; $\Delta R^2 = 0.024$, $P < 0.001$). Table IV displays the simple slope coefficients for the significant two-way interactions which were between (i) knowledge and smoking status; (ii) knowledge and age; (iii) perceived susceptibility and age and (iv) perceived susceptibility and time trying to conceive. As shown in Table IV, knowledge was positively associated with medical help-seeking intentions among women who smoked < 10 cigarettes per day and the positive association was even stronger among women who smoked 10 or more cigarettes per day. In addition, knowledge was associated with heightened intentions to seek medical help among women aged 34 or younger but not among women older than 34.

The relationship between perceived susceptibility and medical help-seeking intentions differed according to age. Slope analyses indicated that this interaction occurred because the slopes differed significantly from each other, with the association being positive (but not significantly different from 0) among women aged 34 or younger and negative (but not significantly different from 0) among women older than 34. Further, perceived susceptibility was related to stronger intentions to seek medical help among women who had been trying to conceive for 12 months or more but was unrelated to intentions among women who had been trying to conceive for < 12 months.

The predictive power of the lifestyle change intentions model was significantly improved by adding three-way interaction terms (i.e. interaction between infertility risk status, knowledge and perceived susceptibility) to the regression ($F(21, 613) = 3.495$, $P < 0.001$, $\text{MSE} = 1.827$; $\Delta R^2 = 0.021$, $P < 0.01$). As shown in Fig. 1, among women who smoked 10 or more cigarettes per day, having fertility knowledge was associated with stronger intentions to engage in lifestyle change when perceived susceptibility was high ($\beta = 0.311$, $P < 0.01$) but was unrelated to lifestyle change intentions when perceived susceptibility was low ($\beta = -0.147$, $P = 0.3$). By contrast, among women who smoked < 10 cigarettes per day, knowledge was not related to lifestyle change intentions either when perceived susceptibility was high ($\beta = 0.104$, $P = 0.152$) or when perceived susceptibility was low ($\beta = 0.094$, $P = 0.263$).

Two- and three-way interaction terms were not significant for non-medical help-seeking intentions.

Table III Summary statistics for hierarchical regression testing direct associations and moderation in medical help-seeking intentions, non-medical help-seeking intentions and lifestyle change intentions.

	Medical help-seeking intentions, <i>n</i> = 1178	Non-medical help-seeking intentions, <i>n</i> = 451	Lifestyle change intentions, <i>n</i> = 634
Step 1: Main effect control variables	$R^2\Delta = 0.01^{***}$	$R^2\Delta = 0.00$	$R^2\Delta = 0.02^{***}$
Education	0.11 ^{***}	0.00	0.13 ^{***}
Economic hardship	0.04	0.05	0.09*
Step 2: Main effect infertility risk status	$R^2\Delta = 0.07^{***}$	$R^2\Delta = 0.01$	$R^2\Delta = 0.04^{***}$
BMI	0.01	0.01	0.14 ^{***}
Number of cigarettes per day	-0.06*	-0.02	0.06
Age	-0.00	-0.02	0.04
Time trying to conceive	-0.08 ^{**}	-0.03	0.00
Main effect fertility knowledge and perceived susceptibility			
Fertility knowledge	0.19 ^{***}	0.04	0.1*
Perceived susceptibility	0.15 ^{***}	0.10	0.02
Step 3 ^a : two-way interactions infertility risk status and fertility knowledge/perceived susceptibility	$R^2\Delta = 0.02^{***}$	$R^2\Delta = 0.02$	$R^2\Delta = 0.02$
Fertility knowledge × number of cigarettes per day	0.07*	0.07	0.07
Fertility knowledge × age	-0.09 ^{**}	-0.02	0.01
Perceived susceptibility × age	-0.15 ^{**}	-0.12	-0.03
Perceived susceptibility × time trying to conceive	0.15 ^{**}	0.17	0.15
Step 4 ^a : three-way interactions infertility risk status, fertility knowledge and perceived susceptibility	$R^2\Delta = 0.00$	$R^2\Delta = 0.01$	$R^2\Delta = 0.02^{**}$
Fertility knowledge × perceived susceptibility × number of cigarettes per day	0.08	0.15	0.23 ^{***}

Standardized coefficients reported.

^aInteractions significant for at least one dependent variable are reported.

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

Table IV Simple slope regression coefficient matrix for two-way interactions that predicted medical help-seeking intentions.

	Fertility knowledge	Perceived susceptibility
Risk factor thresholds		
Smoke cigarettes per day		
< 10	0.19 ^{**}	-
≥ 10 (Risk)	0.35 ^{***}	-
Age in years		
≤ 34	0.19 ^{**}	0.1
> 34 (Risk)	-0.03	-0.13
Months trying to conceive		
< 12	-	0.10
≥ 12 (Risk)	-	0.25 ^{***}

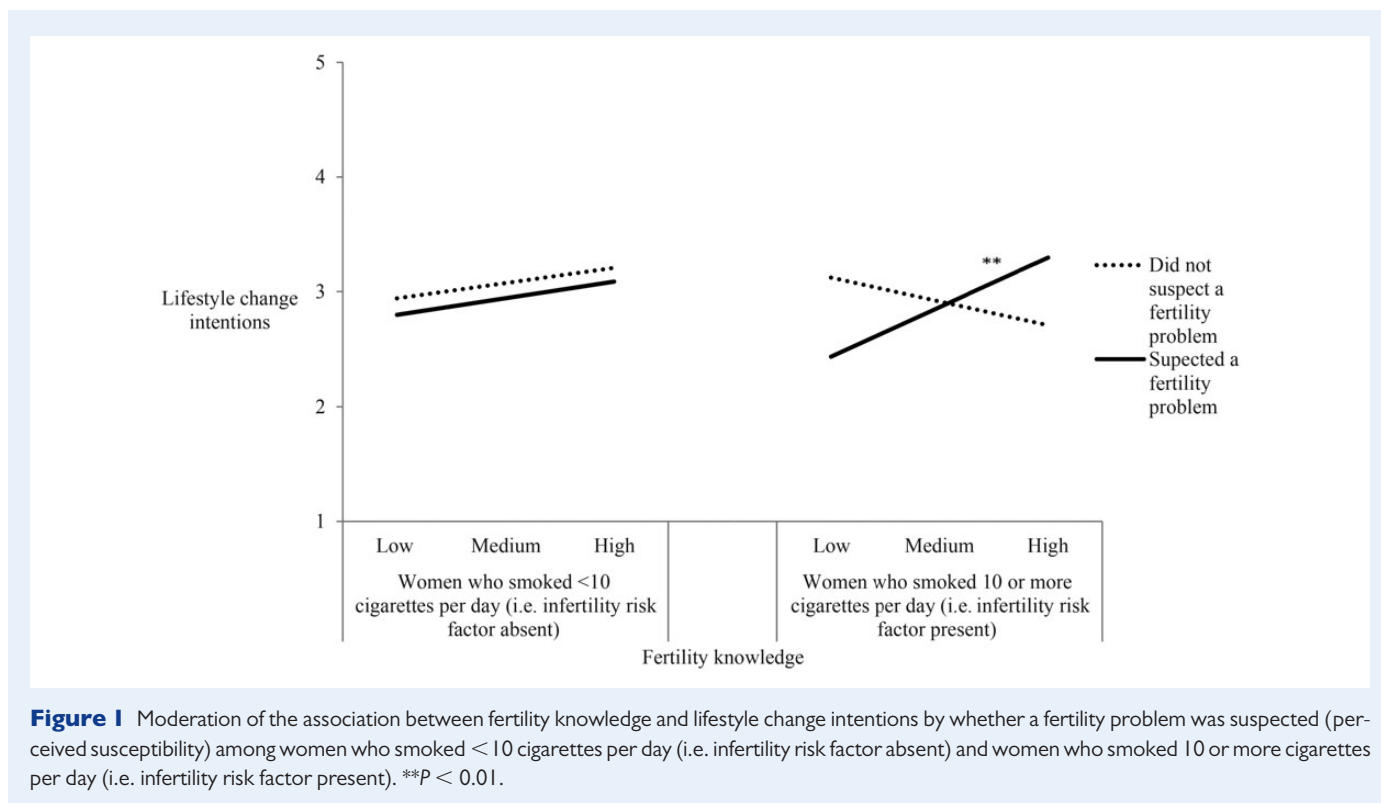
Standardized coefficients reported. Coefficients indicate strength of association (and significance) between medical help-seeking intention and fertility knowledge (or perceived susceptibility) when risk present/absent. Only coefficients from significant two-way interactions are shown (see Table III).

** $P < 0.01$, *** $P < 0.001$.

Discussion

Women's intentions to take action to improve their chance of getting pregnant depend on how much they know about fertility, how vulnerable they feel to infertility and their level of risk of infertility. Being able to correctly identify fertility risks, myths and facts because of greater fertility knowledge and feeling susceptible to infertility are the most salient correlates of readiness to seek medical help. Being overweight is the most relevant factor among those intending to change their lifestyle. Of concern is the finding that being at risk of infertility can actually reduce the likelihood of intending to optimize pregnancy chances. Specifically, women who smoked and those who were medically infertile (defined as had been trying to conceive for over a year) were less likely to intend to seek medical help in relation to their attempts to conceive.

The present results support the HBM in that knowledge and perceived susceptibility are critical in understanding when people become willing to optimize their fertility. Importantly, the role played by knowledge and perceived susceptibility in intentions to optimize fertility varies according to the characteristics of the target population (presence and type of infertility risk factor) and the type of fertility-optimizing behaviour (medical help-seeking or lifestyle change). Improving fertility knowledge and awareness of personal susceptibility to infertility could help women choose the most appropriate strategy to achieve their parenthood goals (e.g. make healthy lifestyle adjustments, consult a doctor).



However, barriers to help-seeking among older women, who are not responsive to knowledge or perceived susceptibility, need to be further investigated.

Women in the present sample were likely to have compromised fertility. The prevalence of infertility risk factors ranged from 14.6 to 51.8%. The risk factors were established using the empirically identified and validated critical thresholds of the FertiSTAT which discriminate to a high degree medically confirmed fertile and infertile women (Bunting and Boivin, 2010). Importantly, over half of the women in the present sample met the medical criteria for infertility (as defined by not having conceived after 1 year of trying). The presence of these risk factors indicates that many of these women may have difficulties achieving their childbearing goals. Consistent with this risk profile, most women also suspected themselves (or their partners) to have a fertility problem (of those who suspected a problem; 52.1% self, 10.7% partner, 37.2% both).

Paradoxically, most women had this suspicion despite relatively poor knowledge about fertility. The sample answered roughly only half of the CFKS items correctly. This suggests that people may lack knowledge about what to do to optimize their chances of pregnancy and alleviate their concerns about their fertility.

Feeling susceptible to infertility and being more knowledgeable about fertility were (overall) associated with greater likelihood of intending to optimize the chance of pregnancy. However, the role of knowledge and perceived susceptibility varied according to type of behaviour and risk status. For example, interactions showed that heavy smokers who knew the causes of infertility (such as smoking) intended to consult a doctor presumably because they recognized that smoking was a risk factor for infertility. However, to be motivated to take the ultimate step of lifestyle change (i.e. quit smoking) they needed to additionally believe that infertility could happen to them. This suggests that

educational interventions to promote healthy lifestyle and timely help-seeking when fertility problems are encountered will be most effective if they are tailored to the infertility risk factors present in the target audience.

The present findings are in line with previous health research showing that smokers who do not feel susceptible to the negative health effects of smoking have lower intentions to quit smoking (Norman *et al.*, 1999; Dillard *et al.*, 2006). While most smokers know that smoking increases risk of a multitude of diseases, they underestimate their susceptibility to the health effects associated with smoking (Williams and Clarke, 1997; Arnett, 2000; Dillard *et al.*, 2006), which may be a major barrier to behaviour change. Smokers who wish to become parents may ignore medical advice to quit smoking if they do not feel vulnerable to fertility problems. Medical practitioners should consider using tools such as the FertiSTAT to provide patients with personalized risk information regarding their chance of fertility. Giving personalized feedback about risk of a disease, based on factors such as health status and the presence of symptoms, is effective at increasing behaviours which are linked to improved fertility including smoking cessation, physical activity and healthy eating (e.g. Cupples and McKnight, 1999; Parkes *et al.*, 2008; Colkesen *et al.*, 2011).

In the present study older women (aged 35 or above) were not responsive to knowledge or perceived susceptibility, suggesting that there is a critical age range (below age 35) in which these variables are important in decision-making about having children. Lack of efforts to safeguard fertility among older women may be driven by the belief that there are limited options available for age-related infertility and as such consulting a doctor would be futile even when a fertility problem is suspected. This belief may be especially possible given the existence of international social norms that dictate acceptable age deadlines for

women giving birth. In a survey of 25 European countries, 14 of which were the country of residence for participants in the present study, the majority of participants in each country (77.5–100% depending on country) perceived a maternal age deadline for childbearing with a mean of 41.7 years (Billari et al., 2011). People comply with these norms, with fewer women having children at older ages in countries in which social age deadlines exist (Billari et al., 2011). Societal expectations regarding the timing of childbirth could potentially dissuade older women from investigating relevant childbearing options, even though medical procedures such as ART could help them reach parenthood, especially if sought in a timely way (i.e. as soon as a fertility problem is suspected) (Templeton et al., 1996; Lintsen et al., 2007). To help older women achieve their child-bearing goals, it is imperative to investigate the factors that motivate them to consult with fertility medical services, including the role of beliefs about available medical interventions and perceived norms regarding maternal age at childbirth. Similarly, to understand non-medical help-seeking it may be necessary to take into account a broader range of variables than was measured in the present study. Use of non-medical sources may represent a preliminary form of help-seeking that occurs before couples become aware of and gain knowledge about problems with their fertility (Blenner, 1990). An important consideration for fertility educational campaigns is that the factors that influence help-seeking may differ across countries; for example belief in the negative effects of fertility treatment (physical, emotional) tends to be higher in countries with greater socio-economic development (Bunting et al., 2013).

In the present study, perceived susceptibility to infertility was defined as whether participants suspected that they or their partner had a fertility problem. It is possible that intention to take action differed according to whether participants believed it was they or solely their partner who had a fertility problem. For example, motivation to make lifestyle changes may be lower among women who suspect that the fertility problem originates from their partner, perhaps especially if the infertility is attributed to a lifestyle habit (e.g. smoking). It would be important for future research to examine the impact of perceived causes of personal and/or partner infertility on whether and what action people intend to take to improve their pregnancy chances. However, it is common practice to treat infertility as a couple rather than individual problem and couples experiencing problems conceiving are seen together by fertility services, because both partners are a part of decision-making about investigation and treatment (NICE, 2013). Chances of conception (naturally and through fertility treatment) among couples having problems conceiving are improved by seeking help and reducing negative lifestyle habits regardless of which partner is suspected to be infertile (NICE, 2013). According to the HBM, if an individual suspects that they are having difficulty conceiving, even if they believe the difficulty to be due to a fertility problem with their partner, they will be more likely to take action (e.g. seek advice from a doctor) to reduce the threat and increase the chance of pregnancy for the couple.

This study provides insight into the context of behaviour change among women who are trying to get pregnant and demonstrates the complex interplay between knowledge, perceived susceptibility and objective infertility risk status. It is important to consider that the data were cross-sectional and thus we cannot infer causality. In addition, the sample was biased towards high levels of perceived susceptibility, potentially due to the recruitment method (i.e. websites targeted at people currently trying to conceive) which likely captured individuals who

were concerned about their fertility. However, as none of the women had sought medical advice regarding their attempts to get pregnant, the relationship with fertility-optimizing intentions is not contaminated with treatment experience and should reflect genuine predictive associations between variables. Online samples are associated with higher education (Haagen et al., 2003). However, the present sample was comparable with the population on key variables. For example, the mean age in the overall sample was 28.5, which is comparable with mean maternal age at first birth in the UK (29.5 years; Office for National Statistics (ONS), 2011b). In terms of the prevalence of unhealthy lifestyle factors, 26.6% of the present sample smoked in comparison with 20% of women in the UK (Office for National Statistics (ONS), 2011a). Intentions do not always translate into behaviour (Scholz et al., 2008) and as such we cannot be certain that individuals who intend to optimize their fertility will do so. However, research in other domains shows that intentions correlate highly with behaviour, in the range of 0.75–0.82 (Ajzen, 1991). The present study shows that what people know about fertility and how vulnerable they feel to infertility, as well as their objective level of infertility risk, plays a role in how ready they are to make lifestyle changes and/or consult with a doctor in relation to their fertility. Future prospective research should investigate the factors influencing the likelihood of individuals realizing their plans to optimize their fertility.

In conclusion, the present results suggest that when deciding what to do about their fertility, people try to match their current needs to the most appropriate solution. For example, heavy smokers will seek advice from a doctor when they are aware that smoking can reduce fertility but will not make plans to quit smoking until they have reached the stage of worrying about their chance of getting pregnant. Tools providing tailored information about one's risk of infertility (e.g. FertiSTAT) may increase risk awareness among this group. On the other hand, older women avoided medical help-seeking even when they knew that age affects fertility and felt susceptible to infertility, possibly because of reduced confidence in the availability or effectiveness of fertility treatment at advanced ages. Barriers to help-seeking among older women must be further explored in order to promote timely decision-making about fertility.

Acknowledgements

The authors thank Lorraine Woods, Laura Morris and Phillip Fayers (Cardiff University) for their invaluable web support and Sian Austin for her coordination of IFDMS translations. We thank the International placement partners (BabyCentre, www.babycentre.co.uk; Clearblue, www.clearblue.com; iCSI, International Consumer Support for Infertility, www.icsi.ws; Ipsos SANTE, www.ipsos.fr) and webmasters and clinics for their willingness to post links and recruit participants for the IFDMS. For a full list of the websites and clinics who recruited participants, please see Bunting et al. (2013).

Authors' roles

B.F., L.B. and J.B. contributed to the conception and design of the study and the analysis and interpretation of data. They drafted all versions of the article and approved the final version for publication. L.B. and J.B. contributed to the acquisition of data. I.T. contributed to the conception and design of the study, acquisition of data, the revisions of each version and the approval of the final version for publication.

Funding

Merck-Serono S. A. Geneva-Switzerland (an affiliate of Merck KGaA Darmstadt, Germany) and the Economic and Social Research Council (ESRC, UK) funded this project (RES-355-25-0038, 'Fertility Pathways Network'). L.B. is funded by a postdoctoral fellowship from the Medical Research Council (MRC) and the ESRC (PTA-037-27-0192). B.F. is funded by an interdisciplinary PhD studentship from the ESRC/MRC (ES/1031790/1).

Conflict of interest

The research was partially funded by Merck-Serono S. A. Geneva-Switzerland (an affiliate of Merck KGaA Darmstadt, Germany) and I.T. is an employee at this company.

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