Misperceptions of ovarian cancer risk in women at increased risk for hereditary ovarian cancer

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This study has been approved by the appropriate ethics committee and has therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

ABSTRACT

Background: This study assessed the sociodemographic, medical and psychological predictors of accuracy of perceived risk in women at increased genetic risk for ovarian cancer.

Methods: Women participating in a large cohort study who were at increased risk of ovarian and fallopian tube cancer, had no personal history of cancer and had ≥ 1 ovary *in situ* at cohort enrolment, were eligible. Women completed self-administered questionnaires and attended an interview at enrolment.

Results: Of 2,868 women unaffected with cancer at cohort enrolment, 561 were eligible. 335 women (59.8%) overestimated their ovarian cancer risk, while 215 women (38.4%) accurately estimated their risk, and 10 (1.8%) underestimated it. Women who did not know their mutation status were more likely to overestimate their risk (OR 1.74, 95% CI 1.10, 2.77, *p*=0.018), as were those with higher cancer-specific anxiety (OR 1.05, 95% CI 1.02, 1.08, *p*<0.001) and/or a mother who had been diagnosed with ovarian cancer (OR 1.98, 95% CI 1.23, 3.18, *p*=0.005). Amongst the group of women who did not know their mutation status, 63.3% overestimated their risk and the mean perceived lifetime risk of developing ovarian cancer was 42.1%, compared to a mean objective risk of 6.4%.

Conclusions: A large number of women at increased risk for ovarian cancer overestimate their risk. This is of concern especially in women who are at moderately increased risk only; for this sub-group of women, interventions are needed to reduce potentially unnecessary psychological distress and minimise engagement in unnecessary surgery or screening.

Ovarian cancer is not highly prevalent, however it is associated with high mortality with a 5-year survival rate of 40% [1]. Approximately 15% of invasive ovarian cancers are due to an inherited predisposition [2, 3]}.Women with a family history of breast and/or ovarian cancer are at significantly increased risk for ovarian cancer, as are women from families with hereditary non-polyposis colorectal cancer. Women who are carriers of germline mutations in the breast/ovarian cancer susceptibility gene, *BRCA1*, are estimated to have a lifetime risk of ovarian cancer of about 40% [4], while mutations in the second breast/ovarian cancer susceptibility gene, *BRCA2*, and those related to hereditary non-polyposis colorectal cancer, are associated with a lifetime risk of about 10% [4, 5]. Given that the lifetime risk of ovarian cancer is approximately 1% in the female population [6], women from families affected by these hereditary cancer syndromes are at greatly increased risk of ovarian cancer.

It is now recognised that fallopian tube and primary peritoneal carcinomas are histologically and clinically identical to invasive serous epithelial ovarian cancer and have a common embryological origin, with many now considered to be derived from the fimbria of the fallopian tubes [7]. However for the sake of brevity, this group of cancers will be referred to as 'ovarian cancer' hereafter, although arguably the term 'ovarian cancer' is misleading and the best terminology is being debated at present.

Little is known about the accuracy of ovarian cancer risk perception in women at increased genetic risk of developing ovarian cancer. To date, two studies have measured the accuracy of ovarian cancer risk perception in women with a family history of the disease [8, 9], and in *BRCA1* and *BRCA2* carriers prior to risk-reducing oophorectomy [10]. In a familial ovarian cancer clinic setting, women were more likely to underestimate (44%), than overestimate (10%) their ovarian cancer risk; 37% were accurate in their risk perception [8]. In contrast,

from a sample of 117 women attending a familial ovarian cancer screening clinic, women were more likely to accurately estimate their risk (56%), compared to 27% and 17% who overestimated or underestimated their ovarian cancer risk, respectively [9]. Amongst *BRCA1* carriers, 38% correctly estimated their risk, while 47% overestimated and 16% underestimated their risk. A similar proportion (37%) of *BRCA2* carriers accurately estimated their ovarian cancer risk; however the majority (61%) overestimated, with only 2% of women underestimating, their risk [10]. None of these previous studies assessed the sociodemographic, medical and psychological predictors of accuracy of perceived risk.

Greater knowledge of accuracy of risk perceptions is important because of the known influence of perceived risk on health beliefs and health behaviours. For example the Health Belief Model, the Transactional Model of Stress and Coping and Self-Regulation Theory, all emphasise perceived risk or susceptibility as a key dimension underlying uptake of screening recommendations and preventative behaviours [11-14]. Studies that examined the influence of breast cancer risk perception on uptake of recommended screening have been inconsistent, suggesting that women who overestimate their risk both under- and overutilise recommended screening [15-17]. In contrast, high perceived ovarian cancer risk is associated with increased uptake of ovarian cancer screening [18, 19]. This is particularly concerning given the ineffectiveness, both singly and in combination, of current screening methods to detect early ovarian cancer and the potential of these to cause harm [20-22].

Heightened perceived risk for ovarian cancer is also associated with uptake of risk-reducing salpingo-oophorectomy among women who underwent genetic testing for *BRCA1* and *BRCA2* mutations [19]. Given that risk-reducing salpingo-oophorectomy significantly reduces the

incidence of ovarian cancer and associated mortality [23, 24], heightened risk perceptions may represent a powerful incentive for women to adopt this effective preventative strategy. This potential benefit, however, must be considered within the context of the psychological burden associated with heightened risk perceptions. Conversely, women who underestimate their ovarian cancer risk may not consider risk-reducing surgery, although their objective risk may warrant consideration of such an option.

The sociodemographic, medical and psychological predictors of accuracy of perceived risk in women at increased risk for ovarian cancer based on family history are unknown. This study fills the existing gap in the literature by examining a cohort of women from a large registry of multiple-case breast and ovarian cancer families. We hypothesise that accuracy of perceived risk will be predicted by: the number of close relatives with ovarian cancer, knowledge of one's *BRCA1* and *BRCA2* mutation status, diagnosis of one's mother and/or sister with ovarian cancer and increased cancer-specific anxiety.

METHODS

Sample

Unaffected women participating in two components (the Clinical Follow-up study and the Psychosocial study [25]) of a large epidemiological and clinical study of multiple-case breast cancer families from Australia and New Zealand (the **K**athleen Cuningham Foundation **Con**sortium for Research into **Fa**milial **B**reast Cancer - kConFab), formed the study sample [26, 27]. All participants gave their informed consent prior to inclusion into the study. Families were recruited after the index family member attended a consultation at one of 16

family cancer clinics (FCC). Eligibility criteria for families were complex, but included a strong family history of breast cancer and/or ovarian cancer, or a documented *BRCA1* or *BRCA2* mutation [26, 27]. Blood was drawn for potential mutation analysis at enrolment (although only key individuals in each family were actually tested initially) and epidemiology and family history questionnaires were completed. Unless the individual had already attended an FCC, genetic counselling was not required before research-based genetic testing. When a *BRCA1* or *BRCA2* mutation was found in the index family member, all enrolled family members who had previously indicated they would like to receive such information were notified that relevant genetic information had become available and were invited to attend a FCC for genetic counselling and personal genetic testing for the family mutation. Overall 41.2% of individuals attended a familial cancer clinic for genetic testing [28].

Longitudinal follow-up and psychosocial data were collected in parallel using three-yearly self-report questionnaires and a semi-structured interview [25]. Cancer events, risk management practices, epidemiological and lifestyle risk factors, cancer risk perception, psychological variables, personality characteristics, levels of social support and life-event stress were updated every three years. The analysis reported here describes data collected at cohort entry only.

To be eligible for the current analysis, women had to have no personal history of cancer (except non-melanoma skin cancer or cervical intraepithelial neoplasia CIN I-III) at the time of enrolment, have at least one ovary *in situ* at the time of cohort enrolment and be at increased risk for ovarian cancer (i.e. carry a *BRCA1* or *BRCA2* mutation and/or have at least one first- or second-degree relative with ovarian cancer). Women who were found to be non-

carriers of the *BRCA1* or *BRCA2* mutation segregating in their family and knew their mutation status at cohort entry were excluded from analyses.

Measures

Predictor variables

Demographics: Age, educational level (university-educated or high school-educated), marital status and parity at enrolment were collected at interview.

Family history: Total number of first- and second-degree relatives diagnosed with ovarian cancer, and whether the woman's mother or (at least one of) her sister/s died from ovarian cancer at enrolment were recorded and verified where possible.

Genetic testing results: Women's genetic test results (for those in whom a mutation was identified in their family) were based on kConFab records rather than self-report. Participants' knowledge of their mutation status was determined during the psychosocial interview and verified, where possible, from kConFab records. Whether a woman had attended a familial cancer clinic was ascertained as part of the Clinical Follow-Up study.

Cancer-specific anxiety: This was assessed using the seven-item Intrusive Thoughts subscale of the Impact of Event Scale (IES) [29]. Intrusion was defined as 'the involuntary entry into awareness of ideas, memories and emotions.' Specifically, participants were asked about the frequency and severity of intrusive thoughts about being at risk of developing breast /ovarian cancer in the past week, ranging from 'Not at all' to 'Often'. Scores ranged from "0-35", with higher scores indicating more intrusive thoughts [30]. Internal consistency (Cronbach's α=0.88) and test-retest reliability (*r*=0.75) of this subscale have been reported previously in high-risk women [31].

Dispositional Optimism: The Life Orientation Test (LOT) was included to assess dispositional optimism. It is a widely used questionnaire with well-documented psychometric properties [32]. Scores range from 0 to 32, with higher scores indicating more optimism.

Social support: This was assessed by the Duke-UNC Functional Social Support Questionnaire [33]. This 8-item scale is a validated measure of the degree of satisfaction with available support. Scores range from 8 to 40, with higher scores indicating more social support.

Perceived lifetime risk of developing ovarian cancer: This was assessed by asking participants to indicate their perceived risk on a numerical differential scale ranging from 0 ('No chance') to 100 ('Definitely'). This item has been used previously in similar studies [34].

Objective lifetime risk of developing ovarian cancer: At cohort entry, objective lifetime risk was calculated using the Breast and Ovarian Analysis of Disease Incidence and Carrier Estimation Algorithm (BOADICEA), which can be used to estimate the risks of developing ovarian cancer by age 70. The algorithm is based on segregation analysis of breast and ovarian cancer occurrence in a population-based series of 1484 breast cancer cases and 156 multiple case families from the United Kingdom [35].

Outcome variable

Accuracy of perceived risk: Accuracy of perceived risk was determined by comparing a woman's objective lifetime risk according to BOADICEA to her perceived risk of developing ovarian cancer. If the woman's objective lifetime risk was within ±25% of her perceived risk, she was categorised as accurately perceiving her risk; and if it was more than 25% below or above her objective risk she was categorised as an underestimator or overestimator respectively.

Statistical analysis

Data were initially explored with descriptive statistics. The continuous predictor variables, cancer-specific anxiety, total number of relatives diagnosed with ovarian cancer, and social support were non-normally distributed; Kruskall-Wallis tests were used in the bivariate analyses of these variables. The continuous predictor variables age and optimism were normally distributed; ANOVA tests were used in the bivariate analyses of these variables. To explore the associations between the categorical predictor variables (marital status, education, country of birth, parity, mutation status, sister or mother diagnosed with ovarian cancer) and the binary perceived risk variable, Pearson chi square tests was used.

As there were only a very small number of underestimators (N=10, 1.8%), this group was not included in the logistic regression due to insufficient power. Covariates with $p<0.25$ in bivariate analyses were entered into a logistic regression [36]. A progressive backward elimination modelling strategy was used until a final model was obtained containing only variables with $p<0.05$.

Results

This study was undertaken as part of a larger study, which also assessed the psychological factors associated with uptake of risk-reducing salpingo-oophorectomy [37]. Of the entire sample of 2,868 unaffected women included in both the kConFab Psychosocial and Clinical Follow-Up studies, the final sample consisted of 561 women, who met all the eligibility criteria for this current analysis. The vast majority of ineligible women (2,054) were ineligible because they did not have an increased risk of ovarian cancer. See Figure 1 for a description of establishing the final sample size.

[Insert Figure 1 about here]

Table 1 describes the baseline characteristics of the sample. The mean age of the sample was 42.8 years (standard deviation, 12.4 years). 411 (73.3%) women were parous. The median number of first- and second-degree relatives diagnosed with ovarian cancer was one (range 0-12). Of the 561 women included in this study, 145 (25.8%) had a mother diagnosed with ovarian cancer, while 56 (10.0%) reported a sister diagnosed with ovarian cancer. In terms of knowledge of mutation status, 119 (25%) reported having had genetic testing and having been informed of their mutation positive result, while 353 (75%) reported not having had genetic testing; the reason for non-testing are not known. Two hundred and thirty-one (41.2%) women reported having attended a familial cancer clinic. Three hundred and thirty-five women (59.8%) overestimated their ovarian cancer risk, while 215 women (38.4%) accurately estimated their risk, and 10 (1.8%) underestimated ovarian cancer risk.

[Insert Table 1 about here]

Table 2 shows the percentages of underestimates, accurate estimators and overestimators for each of the categorical predictor variables including the results of bivariate analyses, while Table 3 shows the same data for each of the continuous variables. Table 2 shows that, amongst women who did not know their mutation status, 63.3% overestimated their risk, compared to 47.1% who were tested and were aware they were carriers. Additional analyses (not shown) showed that 23.4% of women who did not know their mutation status overestimated their actual lifetime by more than 50%. Amongst the group of women who did not know their mutation status, the mean perceived lifetime risk of developing ovarian cancer was 42.1% (SD 25.9), compared to a mean objective risk of 6.4% (SD 11.8).

[Insert Tables 2 and 3 about here]

Table 4 summarises the results of the logistic regression. Women who did not know their mutation status were more likely to overestimate their risk (OR 1.74, 95% CI 1.10, 2.77, $p=0.018$), as were those with higher cancer-specific anxiety (OR 1.05, 95% CI 1.02, 1.08, $p<0.001$) and/or a mother who had been diagnosed with ovarian cancer (OR 1.98, 95% CI 1.23, 3.18, $p=0.005$) were more likely to overestimate their risk.

[Insert Table 4 about here]

Discussion

Our study aimed to explore the sociodemographic, medical and psychosocial predictors of accuracy of ovarian cancer perceived risk. Most of our hypotheses were confirmed in that women who did not know their mutation status, had a mother who was diagnosed with ovarian cancer and those with higher levels of cancer-specific anxiety were more likely to overestimate their lifetime risk of ovarian cancer.

Compared to the published literature on the accuracy of risk perception for ovarian cancer, our study encountered the largest proportions of misperceptions, with most women (59.8%) overestimating their risk of ovarian cancer by 25% or more. By contrast, only 1.8% underestimated their risk, while 38.4% were accurate in their risk perceptions.

Our finding that women who knew their mutation status were less likely to overestimate their ovarian cancer risk, compared to those who did not know their mutation status, is reassuring. It underscores that learning one's mutation carrier risk helps clarify women's risks of ovarian cancer, resulting in more accurate perceived ovarian cancer risk, which in turn may lead to less cancer-specific anxiety and other psychological benefits, apart from facilitating improved decision-making regarding women's risk management options. Amongst women who did not know their mutation status, the mean perceived lifetime risk was 42.1%, compared to a mean actual risk of 6.5%, indicating that many of these women (many of whom were at only moderately increased risk for ovarian cancer), vastly overestimated their risk as being similar to the risks for *BRCA1* mutation carriers. For intervention planning, it would be important to identify women who are at only moderately increased risk and who overestimate their ovarian cancer risk. Overestimators may be at significantly increased risk of cancer-specific anxiety and other psychological distress. They may also be at increased risk of making decisions regarding risk-reducing salpingo-oophorectomy primarily motivated by anxiety rather than an accurate understanding of their objective risk or be participating unnecessarily in ovarian cancer screening because of their inaccurate risk perceptions.

Our analysis showed that women who had a mother diagnosed with ovarian cancer were more likely to overestimate their risk of developing ovarian cancer. Our other hypothesis that overestimation of risk would be associated with the total number of first- and second-degree relatives and having a sister diagnosed with ovarian cancer was not confirmed. The impact of having a mother who was diagnosed with ovarian cancer on perceived risk reflects both experiential and objective factors. Heightened risk perceptions may develop as a result of vicariously living the cancer experience through a relative, particularly if there is a close relationship [38]. Experiencing a mother's breast cancer and/or death and/or having acted as

her caregiver have been shown to be a psychological risk factors for women at high risk for breast and ovarian cancer [31]. Thewes et al. interpret this observation in the context of attachment theory, which posits that temporary or permanent loss of the primary attachment figure is frequently accompanied by grief, anxiety and mourning [31]. Consequently, the diagnoses of other close relatives (e.g. sisters) might not have the same potential to increase women's perceptions of their own vulnerability. In terms of objective factors, women may conclude there is a shared genetic inheritance with one's mother that increases their risk of developing cancer; unaffected women are at significantly higher risk of developing ovarian cancer even if they have just a single first-degree relative who was diagnosed with ovarian cancer at a young age [39]. The experience of having a mother with ovarian cancer and recognizing the implications this may have on one's own risk may arouse significant concern in unaffected women, leading to overestimation of risk of developing ovarian cancer.

We also found that higher levels of cancer-specific anxiety were associated with risk overestimation. Previous research has shown that there is a consistent association between heightened perceived risk of breast cancer and worry or anxiety [40]. Results from our study support these findings; women who had higher cancer-specific anxiety were more likely to overestimate their risk of ovarian cancer. High levels of anxiety and/or perceived risk also influenced decisions regarding risk-reducing surgery for women at high risk of hereditary breast/ovarian cancer [41, 42]. Furthermore, anxiety about breast cancer may interfere with comprehension of risk information [43], suggesting that women with high levels of anxiety may benefit from anxiety reduction techniques and supportive counselling to normalise anxiety levels and enable risk information to be communicated effectively. A number of studies have shown that interest in risk-reducing salpingo-oophorectomy in women with a family history of ovarian cancer was motivated by a desire to reduce anxiety [44, 45] and was

associated with cancer anxiety rather than objective cancer risk [34]. Given the large numbers of women in this study who overestimated their ovarian cancer risk and the relationship with cancer-specific anxiety, this is of concern. However, Meiser et al. (1999) found no statistically significant association between psychological factors including cancer-specific anxiety and actual uptake of risk-reducing salpingo-oophorectomy in the same sample of women [37]. Nevertheless it is important to be aware that women with inaccurate risk perceptions may be at risk of making significant health behaviour decisions based on cancer anxiety rather than objective risk. Women who have higher cancer-specific anxiety may benefit from interventions designed to correct misperceptions of ovarian cancer risk, e.g. communication aids specifically developed for use in cancer genetic counselling to facilitate communication of breast and/or ovarian cancer risk [46].

Our regression analyses showed that overestimation of risk was unrelated to women's ages. This is in contrast to previous studies, which have found that perceived lifetime risk was inversely related to age [47]. In clinical practice provision of age-specific risks (e.g. risk over the next 10 years) is very important, given that risk management decisions will be influenced by the magnitude of risks at varying ages, in addition to being impacted by childbearing decisions and consideration of the risks of menopausal and sexual symptoms, which in turn are also age-dependent. This study only assessed women's perceived lifetime risks for ovarian cancer; given the importance of age-specific risks, future studies should ask women about perceived age-specific risks.

The other limitations of our study should be noted. About 60% of women in our sample had had no direct contact with a familial cancer clinic and as a result had not received genetic

counselling nor specialist risk management advice regarding their family history and/or risk of developing ovarian cancer. Without accurate or personalized risk information, women may have been much more likely to overestimate their ovarian cancer risk. We did not elicit why women were not tested, which could have been due to personal choice, because they did not understand where to go for testing, or because testing was unavailable. These different groups may well have different subjective risk perceptions that were obscured by pooling them here. Historically it has been difficult to accurately estimate women's ovarian cancer risks, and risk estimation remains a clinically fraught area. The BOADICEA model used in this paper has been validated for breast cancer risk [35, 48], but not for ovarian cancer risk. However due to the lack of established ovarian cancer risk data, it remains the 'gold standard'. Other studies in this area have used different published estimates of objective risk for ovarian cancer [4, 49, 50] , as well as different measures for misperception, which makes comparison between findings challenging.

Conclusion

Our study contributes to the growing literature on the accuracy of perceived risk in women at increased risk of ovarian cancer. In our large sample of unaffected women at increased risk of ovarian cancer, the majority of women overestimated their risk of developing ovarian cancer. It is important to identify women who overestimate cancer risk to potentially reduce unnecessary psychological distress, and minimise engagement in unnecessary surgery, especially in women whose objective risk is only moderately increased. Clinicians should be particularly attuned to the possibility of overestimation of ovarian cancer risk by women who have a mother diagnosed with the disease. Greater understanding of the associations between perceived risk, psychosocial characteristics and health behaviours is important so that risk

assessment and risk management can be targeted to those most at risk of cancer risk misperceptions. Genetic counselling is effective in increasing the accuracy of risk perceptions [41, 51, 52] and may be important in providing information tailored to the individual about hereditary cancer risks, facilitating adaptation to personal risk, and enabling informed decisions about risk management options.

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Characteristics	N (%)

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Table 1. Baseline sample characteristics (N=561)[a]

Age	
Mean (SD) 42.8 (12.4)	
<30	76 (13.7)
30-39	162 (29.2)
40-49	153 (27.6)
50-59	99 (17.8)
60-69	55 (10.6)
70+	6 (1.1)
Marital status	
Married/living as married	400 (73.1)
Widowed/single/divorced	147 (26.9)
Parity	
Has children	411 (73.4)
Does not have children	149 (26.6)
Educational level	
No university education	439 (79.2)
University graduate	115 (20.8)
Country of birth	
Australia	453 (80.7)
New Zealand	53 (9.4)
United Kingdom	29 (5.2)
Other	26 (4.6)
Total number of FDR and SDR with OvCa	
0	77 (13.8)
1	375 (67.1)
2	84 (15.0)
3+	23 (4.2)
Research genetic mutation status	
BRCA1/2 mutation positive	177 (31.6)
BRCA1/2 mutation negative*	163 (29.1)
No mutation identified in family	220 (39.3)
Knowledge of mutation status	
Individual tested and informed mutation positive	119 (25.2)
Individual either not tested or no mutation identified in family	353 (74.8)
Attended familial cancer clinic	
Yes	231 (49.5)
No	236 (51.2)
Mother cancer status	
Diagnosed with OvCa	145 (25.8)
Not diagnosed with OvCa	416 (74.2)
Sister cancer status	
Diagnosed with OvCa	56 (10.0)
No sister or sister not diagnosed with OvCa	505 (90.0)

OvCa = Ovarian cancer; FDR = First-degree relatives with ovarian cancer; SDR = Second-degree relatives with ovarian cancer. [a] = Cell frequencies vary due to missing data for some variables. *These women are true mutation negatives (according to the research genetic testing result) but may have chosen not to have clinical testing, so would be unaware they are mutation negative.

Table 2. Bivariate analyses of accuracy of perceived risk for categorical predictor variables

Predictor variables	Accuracy of perceived risk							
	Underestimator (N=10)		Accurate estimator (N=215)		Overestimator (N=335)			
	N	%	N	%	N	%	χ^2	p
Marital status[a]								
Married/ living as married	6	1.5	160	40.1	233	58.4	3.13	0.21*
Not married/living as married	4	2.7	48	32.7	95	64.6		
Education								
University graduate	2	1.7	48	41.7	65	56.5	0.71	0.70
Not a university graduate	8	1.8	164	37.4	266	60.7		
Children[a]								
Has children	4	1.0	157	38.3	249	60.7	5.95	0.05*
Does not have children	6	4.0	58	38.9	85	57.0		
Knowledge of mutation status								
Individual tested and informed mutation positive	8	6.7	55	46.2	56	47.1	22.49	<0.001*
Individual either not tested or not informed	2	0.6	126	35.8	224	63.6		
Attendance at a familial cancer clinic								
Yes	8	3.5	96	41.6	127	55.0	11.61	0.02*
No	1	0.4	92	39.0	143	60.6		
Family mortality history								
Sister diagnosed with OvCa	0	0.0	21	37.5	35	62.5	1.19	0.54
No sister or sister not diagnosed with OvCa	10	2.0	194	38.5	300	59.5		
Mother diagnosed with OvCa	0	0.0	40	27.8	104	72.2	14.13	0.001*
Mother not diagnosed with OvCa	10	2.4	175	42.1	231	55.5		

χ^2 = chi square test statistic; * entered into regression model; OvCa = ovarian cancer; [a] = Cell frequencies vary from Table 1 due to missing data for accuracy of risk variable.

Table 3. Bivariate analyses of accuracy of perceived risk for continuous predictor variables ($N = 561$)

Predictor variables	Accuracy of perceived risk							
	Underestimator (N=10)		Accurate estimator (N=215)		Overestimator (N=335)			
	Mean	SD	Mean	SD	Mean	SD	χ^2/F	p
Age	37.0	7.8	43.6	12.2	42.4	12.5	1.7	0.18*
Total number FDR and SDR diagnosed with OvCa	0.7	0.8	1.1	1.3	1.2	0.9	14.7	0.001*
Cancer-specific anxiety	8.3	10.3	5.1	7.2	8.1	8.7	21.5	<0.001*
Optimism	22.6	6.1	20.8	5.3	19.0	5.7	8.2	<0.001*
Social support	30.5	8.3	30.9	7.5	29.6	7.8	3.7	0.15*

χ^2 = Kruskal-Wallis test statistic; F = ANOVA test statistic; FDR = First-degree relatives with ovarian cancer; SDR = Second-degree relatives with ovarian cancer; * = Entered into regression model;

Table 4. Final regression model of overestimation of perceived risk for ovarian cancer

Variable	OR*	95% CI OR	p
Knowledge of mutation status	1.74	1.10, 2.77	0.018
No			
Yes (reference category)			
Cancer-specific anxiety	1.05	1.02, 1.08	<0.001
diagnosed with ovarian cancer			
Yes	1.99	1.24, 3.20	0.004
No (reference category)			

Note: Final model: -2 Log likelihood = 579.94; χ^2 = 27.30; p <0.001; OR = odds ratio

Fig1 Description of sample selection from complete psychosocial database