

Original Article

Attitudes toward Risk-Reducing Mastectomy and Risk-Reducing Salpingo-oophorectomy among Young, Unmarried, Healthy Women in Korea

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Purpose This study investigated the attitudes toward risk-reducing mastectomy (RRM) and risk-reducing salpingo-oophorectomy (RRSO) as cancer prevention options for *BRCA1/2* carriers in healthy, young, unmarried Korean women.

Materials and Methods A nationally representative sample of 600 women, aged 20-39 years, completed a questionnaire on socio-demographic variables, preference for genetic testing, and intention to undergo risk-reducing surgeries after receiving information on the cancer risk of *BRCA1/2* mutations and benefits of risk-reducing surgeries.

Results A total of 54.7% and 57.7% had the intention to undergo RRM and RRSO, respectively, on the assumption that they were *BRCA1/2* carriers. Older age and no intention to undergo genetic testing were associated with a reduced likelihood of undergoing RRM (odds ratio [OR], 0.30; 95% confidence interval [CI], 0.14 to 0.61 for age 35-39 years and OR, 0.35; 95% CI, 0.20 to 0.62 for no intention for genetic testing) and RRSO (OR, 0.39; 95% CI, 0.19 to 0.79 for age 35-39 years and OR, 0.30; 95% CI, 0.17 to 0.53 for no intention for genetic testing). Women who chose to be single were likely to undergo risk-reducing surgeries (OR, 1.67; 95% CI, 1.07 to 2.60 for RRM and OR, 1.56; 95% CI, 1.00 to 2.44 for RRSO).

Conclusion More than 50% of healthy, unmarried, young Korean women were inclined to undergo prophylactic surgeries if they were *BRCA1/2* mutation carriers. Further studies on decision-making process for cancer prevention in individuals at high risk for cancer need to be conducted.

Key words *BRCA* mutation, Risk-reducing mastectomy, Risk-reducing salpingo-oophorectomy

Introduction

Mutations in *BRCA1* or *BRCA2* genes are responsible for a substantially increased lifetime risk of breast cancer (57% and 49%, respectively) and ovarian cancer (40% and 18%, respectively) [1]. In the South Korean population, the breast cancer risk until the age of 70 years was estimated to be 49% and 35% in *BRCA1* and *BRCA2* mutation carriers [2]. In case of non-carriers, the lifetime risk of breast and ovarian cancers is 12.9% [3] and 1.4% [4] in Caucasians and 5.8% and 0.7% in South Koreans [5].

Ever since the news of Angelina Jolie's decision to undergo risk-reducing mastectomy (RRM) and risk-reducing bilateral salpingo-oophorectomy (RRSO) in 2013 and 2015, given her *BRCA1* carrier status and family history, made headlines, the public's awareness of double mastectomy and hereditary cancer has increased but with a lack of accurate interpretations [6]. In addition, the breast cancer prevention services such as breast cancer screening, genetic screening, and risk-reducing prophylactic surgeries has increased in Western

countries, a phenomenon known as the "Angelina Jolie effect" [7]. In South Korea, since medical coverage for *BRCA1/2* screening test by the National Health Insurance system started in 2012 and with the rise of the Angelina Jolie effect, the popularity of *BRCA1/2* gene testing and prophylactic management has increased. The number of contralateral mastectomy and salpingo-oophorectomy for prophylactic purposes among breast cancer patients with *BRCA1/2* mutations has also increased [8,9].

Given the increased awareness, insurance coverage for genetic testing, and advancements in genetic testing technologies [8,10], the perceptions of and attitudes to risk-reducing surgeries need to be assessed not only for *BRCA1/2* carriers or breast cancer patients with a family history of cancer but also for generally healthy women. In this study, the attitudes toward RRM and RRSO as cancer prevention options for *BRCA1/2* carriers and factors associated with the preference for risk-reducing surgeries among healthy, young, unmarried South Korean women were assessed.

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Materials and Methods

1. Participants

A cross-sectional telephone survey was conducted in the year of 2020 with 600 cancer-free unmarried women aged 20-39 years. The participants from the 17 regional strata were stratified according to the administrative districts in South Korea. The study population in each stratum was proportionally designated as the total population aged 20-39 in the strata identified by the 2019 resident registration in South Korea. Equal proportions of women aged 20-29 and 30-39 years were recruited. Cell phone numbers were randomly generated for computer-assisted telephone interviews. Three calls were made in cases of no response before moving to the next number. After obtaining consent to participate in the survey, the women were asked about their birth year, residential area, marital status, and past history of cancer; women who were aged ≤ 20 or ≥ 40 years, married, or had a history of cancer diagnosis were excluded.

Besides the sociodemographic variables of education, job, and income, intentions toward marriage and childbearing and family history of breast or ovarian cancer were also recorded. Participants were provided information on lifetime breast and ovarian cancer risks in *BRCA1/2* mutation carriers (maximum 80% and 50%, respectively). Next, the preference for genetic test services for *BRCA1/2* was obtained. Furthermore, information on the reduced risk of breast and ovarian cancers after RRM with reconstruction surgery (up to 90% reduction in the risk of breast cancer) and RRSO (85% reduction in the risk of ovarian cancer and 70% reduction in ovarian cancer-related death), with respect to Angelina Jolie's decision, was provided. It took approximately 5 minutes to explain cancer risk related to *BRCA* mutation and prophylactic surgeries.

2. Data analysis

The study participants' characteristics, including sociodemographic factors; family history of breast or ovarian cancer; and attitudes toward marriage, childbearing, and genetic testing are summarized as numbers and frequencies. Preference for RRM and RRSO according to the characteristics of the participants is presented as a percentage. The association between each participant's character and preference for RRM and RRSO was determined using simple logistic regression analysis. Then, the independent association of each factor with the preference for RRM and RRSO was assessed using multiple logistic regression analysis including all variables. The results are presented as odds ratio (OR) and 95% confidence interval (CI). All statistical analyses were performed using SAS ver. 9.4 (SAS Institute, Cary, NC).

Table 1. Baseline characteristics of the participants

Characteristic	No. (%) (n=600)
Age (yr)	
20-24	102 (17.0)
25-29	192 (32.0)
30-34	201 (33.5)
35-39	105 (17.5)
Education	
High school or below	62 (10.3)
Undergraduate	92 (15.3)
College or above	446 (74.3)
Income (\$/yr)	
None	63 (10.5)
< 30,000	227 (37.8)
30,000-49,999	211 (35.2)
$\geq 50,000$	99 (16.5)
Occupation	
Blue collar	71 (11.8)
White collar	363 (60.5)
Student	72 (12.0)
Others	15 (2.5)
None	79 (13.2)
Residential area	
Metropolitan city	446 (74.3)
Others	154 (25.7)
Family history of breast or ovarian cancer	
Neither	492 (82.0)
Only breast cancer	91 (15.2)
Only ovarian cancer	8 (1.3)
Both	9 (1.5)
Attitude toward marriage and childbearing	
Want children	318 (53.0)
Do not want children	139 (23.2)
Want to remain single	143 (23.8)
Attitude toward genetic test	
Agree	534 (89.0)
Disagree	66 (11.0)

Results

Table 1 shows the baseline characteristics of the study participants. Among 600 women aged 20-39 years, 18% had a family history of either breast or ovarian cancer; 53% intended to marry and bear children, 23.2% intended to marry but did not want to bear children, and 23.8% wanted neither marriage nor childbearing; 89.0% wanted to undergo genetic testing for *BRCA1/2*.

Further, 54.7% and 57.7% had the intention to undergo RRM and RRSO, respectively, on the assumption that they were *BRCA1/2* carriers. As age increased, the proportion of women with the intention to undergo RRM or RRSO

Table 2. Proportion of women who are willing to undergo risk-reducing mastectomy

Variable	Risk-reducing mastectomy (%)	Risk-reducing bilateral salpingo-oophorectomy (%)
Total	54.7	57.7
Age^{a)} (yr)		
20-24	65.7	66.7
25-29	64.1	65.6
30-34	47.3	51.7
35-39	41.0	45.7
Education		
High school or below	56.5	61.3
Undergraduate	54.4	58.7
College or above	54.5	57.0
Income (\$/yr)		
< 30,000	55.9	57.6
≥ 30,000	53.6	57.7
Occupation		
Blue collar	49.3	62.0
White collar	53.7	55.3
Student	65.9	59.7
Others	66.7	73.3
None	59.5	59.5
Residential area		
Metropolitan city	54.3	57.0
Others	55.8	59.7
Attitude to marriage and having children		
Want children	53.1	56.6
Do not want children	49.6	54.0
Want to remain single	62.9	63.6
Family history of breast or ovarian cancer		
Neither	55.3	58.5
Either breast or ovarian cancer	51.9	53.7
Attitude to genetic testing^{a)}		
Agree	57.5	60.9
Disagree	31.8	31.8

^{a)}p < 0.05, for both risk-reducing mastectomy and risk-reducing salpingo-oophorectomy. Other factors did not show significant differences.

decreased from > 65% in the 20-24-age group to around 40% in the 35-39-age group (Table 2). Those who wanted to undergo screening for *BRCA1/2* mutations had a significantly high intention to undergo risk-reducing surgeries (p < 0.05).

Factors associated with the intention to undergo RRM are presented in Table 3. As age increased, the intention to

undergo RRM was less in the 30-34-age group (OR, 0.39; 95% CI, 0.20 to 0.74) and in the 35-39-age group (OR, 0.30; 95% CI, 0.14 to 0.61) than in the 20-24 age group. Women who did not want to undergo genetic testing were less likely to undergo RRM (OR, 0.35; 95% CI, 0.20 to 0.62) than those who wanted to. Women who chose to be single were more likely to undergo RRM than those who did not (OR, 1.67; 95% CI, 1.07 to 2.60).

Factors associated with the intention to undergo RRSO are presented in Table 4, showing comparable results with RRM. Older age and no intention to undergo genetic testing were associated with less preference for RRSO (OR for 30-34 years, 0.49; 95% CI, 0.25 to 0.94; OR for 35-39 years, 0.39; 95% CI, 0.19 to 0.79 compared with 20-24 age group; OR for rejection of genetic testing, 0.30; 95% CI, 0.17 to 0.53). Women who chose to be single were more likely to undergo RRSO than those who did not (OR, 1.56; 95% CI, 1.00 to 2.44).

Discussion

This study assessed the attitudes toward risk-reducing surgeries, namely RRM and RRSO, in a representative sample of unmarried women aged 20-39 years who did not undergo *BRCA1/2* screening or counseling in South Korea, on the assumption that they were carriers of the *BRCA1/2* mutation. Most previous studies on the uptake of prevention options, including risk-reducing surgeries, focused on *BRCA1/2* mutation carriers or high-risk women; limited information exists on generally healthy women who have never received genetic counseling or screening.

In all, 54.7% and 57.7% of the young women had a positive attitude toward RRM and RRSO, respectively. Our percentages are higher than that reported a study in Italy where only 24.3% of the young women chose RRSO in a hypothetical scenario of *BRCA1/2* carrier status [11] and higher than those reported in a study targeting high-risk women who underwent genetic counseling (23.3% and 42.5% considered RRM and RRSO, respectively) [12]. A study conducted in South Korea also reported that only 27% of the patients from outpatient plastic surgery clinics agreed to undergo RRM if necessary [13]. However, a recent study on women who received genetic counseling showed that 49.2% and 61.3% of women had intentions to undergo RRM and RRSO, respectively [14], comparable with our results, with strong intentions in unaffected *BRCA1/2* mutation carriers (63% and 89% for RRM and RRSO, respectively) [15]. Increased awareness after the Angelina Jolie effect and genetic counseling may have caused the increased interest in risk-reducing surgeries, especially RRM [7] and the increased preference for risk-reducing surgeries would reflect this. In South Korea, since

Table 3. Attitudes toward risk-reducing mastectomy among those who assumed they were a *BRCA* carrier

Variable	OR (95% CI)	
	Crude OR	Adjusted OR ^{a)}
Age (yr)		
20-24	1	1
25-29	0.93 (0.56-1.54)	0.75 (0.39-1.43)
30-34	0.47 (0.29-0.77)	0.39 (0.20-0.74)
35-39	0.36 (0.21-0.64)	0.30 (0.14-0.61)
Education		
High school or below	1	1
Undergraduate	0.92 (0.48-1.76)	0.81 (0.37-1.76)
College or above	0.92 (0.54-1.58)	0.99 (0.55-1.80)
Income (\$/yr)		
< 30,000	1	1
≥ 30,000	0.91 (0.66-1.26)	0.94 (0.66-1.34)
Occupation		
Blue collar	1	1
White collar	1.19 (0.72-1.99)	1.18 (0.68-2.06)
Student	1.36 (0.70-2.63)	0.82 (0.35-1.93)
Others	2.06 (0.64-6.63)	1.67 (0.49-5.72)
None	1.51 (0.79-2.88)	1.25 (0.63-2.50)
Residential area		
Metropolitan city	1	1
Others	1.07 (0.74-1.54)	1.04 (0.70-1.54)
Attitude to marriage and having children		
Want children	1	1
Do not want children	0.87 (0.58-1.30)	0.91 (0.60-1.39)
Want to remain single	1.50 (1.00-2.24)	1.67 (1.07-2.60)
Family history of breast or ovarian cancer		
Neither	1	1
Either breast or ovarian cancer	0.87 (0.57-1.32)	0.79 (0.51-1.23)
Attitude to genetic testing		
Agree	1	1
Disagree	0.35 (0.20-0.60)	0.35 (0.20-0.62)

CI, confidence interval; OR, odds ratio. ^{a)}Adjusted for variables in the table.

the public disclosure of Jolie's condition, the number of hospitals and clinicians providing *BRCA1/2* screening and risk-reducing surgeries has rapidly increased [9], resulting in increased preferences in the South Korean population. The aforementioned Italian study asked women to choose only one option among several risk-reducing options, including surveillance, surgery, or oral contraceptives [11]; thus, the overall preference for risk-reducing surgery would be higher.

Previous studies have shown that prevention decisions vary according to age. Older age was associated with a decreased intention to undergo RRM but increased intention to undergo RRSO among high-risk women [12,16,17]. Although a protective effect of RRSO is expected when performed early [18] in *BRCA1/2* mutation carriers, the negative

effects of RRSO, such as infertility, postmenopausal symptoms, and other health and mental problems, especially childbearing issues [12,19] would explain the reduced preference for RRSO. The high risk of early onset breast cancer has been associated with a strong preference for RRM in the young age group as an immediate option for reducing risk [12]. In this study, as age increased, the preference for both RRM and RRSO decreased. In another study, the intention to undergo RRSO in South Korean *BRCA1/2* mutation carriers increased as their age decreased owing to insufficient explanations provided on RRSO to older carriers [20], as seen in our study. In this study, the short explanation on risk-reducing surgeries might emphasize the benefit and neglect the harm, especially childbearing issues of RRSO, present-

Table 4. Attitudes toward risk-reducing bilateral salpingo-oophorectomy among those who assumed they were a *BRCA* carrier

Variable	OR (95% CI)	
	Crude OR	Adjusted OR ^{a)}
Age (yr)		
20-24	1	1
25-29	0.96 (0.57-1.59)	0.86 (0.45-1.65)
30-34	0.54 (0.33-0.88)	0.49 (0.25-0.94)
35-39	0.42 (0.24-0.74)	0.39 (0.19-0.79)
Education		
High school or below	1	1
Undergraduate	0.90 (0.47-1.73)	0.86 (0.40-1.88)
College or above	0.84 (0.49-1.44)	0.93 (0.51-1.70)
Income (\$/yr)		
< 30,000	1	1
≥ 30,000	1.01 (0.73-1.39)	1.08 (0.76-1.55)
Occupation		
Blue collar	1	1
White collar	0.76 (0.45-1.28)	0.69 (0.39-1.22)
Student	0.91 (0.47-1.78)	0.56 (0.23-1.33)
Others	1.69 (0.49-5.83)	1.31 (0.36-4.75)
None	0.90 (0.47-1.74)	0.74 (0.37-1.49)
Residential area		
Metropolitan city	1	1
Others	1.12 (0.77-1.63)	1.11 (0.75-1.65)
Attitude to marriage and having children		
Want children	1	1
Do not want children	0.90 (0.60-1.34)	0.95 (0.63-1.45)
Want to remain single	1.34 (0.89-2.02)	1.56 (1.00-2.44)
Family history of breast or ovarian cancer		
Neither	1	1
Either breast or ovarian cancer	0.82 (0.54-1.25)	0.76 (0.49-1.18)
Attitude to genetic testing		
Agree	1	1
Disagree	0.30 (0.17-0.52)	0.30 (0.17-0.53)

CI, confidence interval; OR, odds ratio. ^{a)}Adjusted for variables in the table.

ing higher preference in younger age groups. The lack of an association between age and intention to undergo RRSO in general young women [11] supports this finding.

BRCA1/2 mutation carriers were likely to undergo prophylactic surgeries if they had children or had more children, suggesting that completion of childbearing is an important factor in the decision-making process [17,21,22]. Previous studies reported that women who wanted to have children in the future and those who wanted more children were less likely to consider prophylactic surgeries than those who did not want children [11]. In this study, attitudes toward marriage were associated with the intention to undergo risk-reducing surgeries, with a positive attitude seen more in women who wanted to be single than in women who did not.

Among breast cancer patients without *BRCA1/2* mutations, married patients chose to receive prophylactic contralateral mastectomy more frequently than unmarried patients [23]. Our study population was composed of unmarried women; thus, the future possibility of marriage was closely associated with the intention to undergo prophylactic surgeries. Thus, not only childbearing but also marriage intentions should be part of the genetic counseling for unmarried young women.

The association between the attitude to undergo genetic testing and intention to undergo prophylactic surgeries has rarely been investigated because most relevant studies targeted women who received genetic counseling. Those who did not want to undergo genetic testing were less likely to undergo risk-reducing surgeries if they were *BRCA1/2*

mutation carriers than those who were open to genetic testing. This may be owing to an insufficient understanding or knowledge. The majority of the general population does not have sufficient knowledge to accurately interpret information on the cancer risk related to *BRCA1/2* mutations [6] and previous knowledge and increased comprehension of genetic testing are associated with an increased odds of intention to undergo RRSO [11]. In addition, unaffected adults with family members who are *BRCA1/2* mutation carriers had a low risk perception, followed by low acceptance of risk-reducing surgeries [24]. Thus, detailed information needs to be provided to the population.

Studies on associations between family history of breast or ovarian cancer and intention to receive prophylactic surgeries in *BRCA1/2* mutation carriers or high-risk women have shown inconsistent results [14,25,26]. Family history of cancer is highly associated with perceived risk [27,28], and perceived risk highly correlated with the increased interest in prophylactic surgeries among high-risk women in most studies [16,25,28]. Studies have shown a strong, complex relationship between family history and intention to undergo prophylactic surgeries, considering the objective impact of risk and subjective impact of the experience of relatives with cancer [25]. Another study on healthy young women did not find an association among the perceived likelihood of cancer risk, family history of breast or ovarian cancer, and intentions to undergo risk-reducing surgeries, similar to this study [11] rather, cancer worry was associated with the intention to undergo prophylactic surgeries. Thus, decision making with respect to cancer prevention could involve people's risk, experience of genetic counseling, comprehension of explanation, and previous knowledge.

Another interesting finding in this study was that in young, healthy, unmarried women, factors associated with RRM and RRSO were similar, with similar strengths of associations. Two reviews involving high-risk women proposed comparable factors and associations with the decision to undergo RRM and RRSO [25,26].

This study had several limitations. First, we used a hypothetical situation involving generally healthy women and not the attitudes of women who were actually at a high risk of breast cancer or were *BRCA1/2* mutation carriers. Their responses could be different from those of individuals at risk such as women with a family history of breast cancer or mutation carriers of highly susceptible genes. Second, though the women's perceived risk or cancer-related worry largely impacted the intention to undergo prophylactic surgery [16,25,28], we did not measure it. Instead, we assessed patients' family history of breast and ovarian cancers. In addition, as participants were selected from the general population of Korea, the individual risks of breast cancer

estimated by breast cancer risk assessment tools and effectiveness of preventive interventions may have been different. Third, previous studies have shown a complex process of decision making, including demographic, socioeconomic, psychological, social, and emotional factors as well as objective information and input from others, for preventive options [25]. However, this study did not include all these factors. Fourth, the understanding regarding the risk of cancer in *BRCA* mutation carriers and the benefits and harms of RRM and RRSO could be limited because information was provided during a telephonic survey. If video materials or internet webpages explaining the cancer risk related to *BRCA* mutation and prophylactic surgeries had been provided before the telephonic survey, the participants would have had more understanding. If video materials or internet webpages explaining the cancer risk related to *BRCA* mutation and prophylactic surgeries had been provided before telephone survey, the participants would have had more understanding. Despite of these limitations, this study included a relatively large representative sample, reflecting the attitudes of women aged 20-39 years in South Korea. In addition, the findings of this study were comparable with those of studies on attitudes toward risk-reducing surgery among women before genetic testing and counseling or the general population [11,12], possibly extending our results to East Asian women with *BRCA1/2* mutations.

In this study, more than 50% of the young, unmarried, healthy Korean women had intentions to undergo RRM and RRSO if they were *BRCA1/2* mutation carriers. Younger age, being unmarried, and desire for genetic testing were associated with a high likelihood of intention to undergo RRM and RRSO. Further studies regarding the intention of well-informed individuals at a high risk for hereditary cancer such as people with a family history of cancer or hereditary gene carriers to undergo RRM and RRSO need to be conducted. In addition, studies are needed to elucidate the decision-making process for cancer prevention in high-risk groups of hereditary or sporadic cancers.

Ethical Statement

This study was approved by the Institutional Review Board of the Hanyang University College of Medicine (IRB no. HYI-20-175-1). Informed consent was obtained from all participants.

Author Contributions

Conceived and designed the analysis: Kim D, Kim SW.

Collected the data: Kim J, Lee BY, Kim SW.

Contributed data or analysis tools: Park B, Kim J, Lee BY.

Performed the analysis: Park B, Yoon J.

Wrote the paper: Park B, Kim D, Kim J, Lee BY, Yoon J, Kim SW.

ORCID iDsBoyoung Park  : <https://orcid.org/0000-0003-1902-3184>Sung-Won Kim  : <https://orcid.org/0000-0001-5687-1380>**Conflicts of Interest**

Conflict of interest relevant to this article was not reported.

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