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ORIGINAL ARTICLE

Attitude towards hereditary cancer risk management among women with cancer in Taiwan

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Abstract

Background Risk management intentions prior to genetic counseling predict risk management uptake following genetic testing. Limited studies examined the attitude and understanding towards genetic counseling/testing in underserved countries. The purposes of this study were to explore knowledge and attitude towards genetic counseling, testing, and risk management for breast and ovarian cancer, and to understand the factors influencing risk management intentions in women with cancer in Taiwan.

Methods Cross-sectional with correlational design was used in this study. Participants were enrolled for genetic testing based on clinical criteria suspected of having hereditary cancer. Survey was conducted using a standardized questionnaire including (1) demographics and personal/family history of cancer; (2) prior experience or consideration of genetic testing and reasons for not considering; (3) perception and attitude towards genetic counseling; and (4) intentions for risk management with a hypothetical *BRCA1* mutation status. Multinomial logistic regression was used to analyze the predictors of participants' intentions for cancer risk management strategies.

Results A total of 430 women with cancer were analyzed in which 51.6% had family history of cancer in first-degree relatives. Only 30.7% had considered genetic testing and 28.4% had known about genetic counseling prior to the study. When prompted with the services of genetic counseling, the attitude towards genetic counseling was fairly positive (score of 19.8 ± 2.9 out of 25). Given hypothetical *BRCA1* mutation status, enhanced breast cancer screening with annual breast MRI was much more accepted than cancer risk reducing interventions. More positive attitude towards genetic counseling (each score point increase) was associated with higher odds of intention for breast MRI (OR 1.20, 95% CI 1.09–1.32) and preventive tamoxifen (OR 1.11, 95% CI 1.02–1.22). Having considered genetic testing prior to the study was associated with higher odds of intention for all four risk management strategies: breast MRI (OR 2.99, 95% CI 1.46–6.11), preventive tamoxifen (OR 1.79, 95% CI 1.00–3.17), risk-reducing mastectomy (OR 2.24, 95% CI 1.13–4.42), and risk-reducing salpingo-oophorectomy (OR 2.69, 95% CI 1.27–6.93).

Conclusion Knowledge of genetic testing and positive attitude towards genetic counseling were associated with increased willingness to consider cancer risk management strategies for hereditary breast and ovarian cancer syndrome. Given the limited knowledge on genetic testing and counseling in the studied population, increasing public awareness of these services may increase adoption of the risk management strategies.

Keywords Hereditary cancer · Risk management · Genetic counseling · Genetic testing

Introduction

Various options are available to women with hereditary breast and ovarian cancer (HBOC) syndrome for early detection or risk reduction of cancer. Strategies include breast MRI screening, risk-reducing mastectomy (RRM), risk-reducing salpingo-oophorectomy (RRSO), and chemoprevention (tamoxifen or raloxifene) based on international

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guidelines [1]. Knowledge on benefits and potential adverse effects associated with risk management modalities could influence women's intention to receive the interventions. It has been shown that risk management intentions prior to genetic counseling or testing predicted risk management uptake following testing [2]. A study conducted in an average cancer risk population used a hypothetical scenario of high breast cancer risk and found that the participants preferred chemoprevention much more than the prophylactic surgeries [3]. Another study examining women's intention to engage in risk-reducing behavior found that having *BRCA* mutation in the hypothetical scenario did not influence the decision to select risk-reducing surgery, though women who perceived that surgery could reduce the risk of ovarian cancer were more likely to select risk-reducing surgery [4]. However, women with known *BRCA1/2* mutation showed willingness to accept risk of adverse effects to achieve a 90% reduction in breast cancer risk, though fertility concern may influence women's preference [5]. Other demographic, medical, family history, and psychological factors have also been shown to influence women's intention to receiving these treatments [6].

Studies have been conducted mostly in countries where genetic counseling and testing for hereditary cancer are widely available. Hereditary cancer counseling conducted by certified genetic counselor could provide information on individualized risks for inherited cancer, indications of genetic testing, and strategies to facilitate screening and management for those at increased risk [7]. Benefits of genetic counseling and/or genetic testing for hereditary cancer risk included: helping to make decisions on surveillance and screening, motivating self-examination, providing information for family members especially those yet unaffected with cancer, reducing concerns about cancer, reducing uncertainty, providing a sense of personal control, and helping to make decisions about preventative surgery. Some identified limitations or barriers to genetic counseling/testing included: anticipated increased worry or emotional reaction (e.g. worry, fear, anger) if test result were positive, concerns about family's reaction or impact on family, concerns about confidentiality, concerns about insurance, and cost [3, 8, 9].

Limited studies examined the attitude and understanding of genetic counseling/testing in underserved countries. Low availability for genetic counseling services and a relatively conservative culture were shown to affect the utilization of genetic testing in Asian countries [10]. With increasing availability and lower cost of genetic testing, and the ongoing development of genetic counseling services in Taiwan, we conducted this study with the aims: (1) to understand the knowledge and attitude towards genetic counseling, (2) to understand the preference for various risk management strategies for breast and ovarian cancer, and (3) to understand the factors associated with attitude towards the different risk management strategies for women with cancer in Taiwan.

Methods

Participants and procedures

Eligible individuals were enrolled between July 2018 and January 2021 at Koo Foundation Sun Yat-Sen Cancer Center (KF-SYSCC) to undergo germline testing of a panel of cancer susceptibility genes. Participants with cancer were selected based on clinical criteria suggesting elevated risk of having hereditary cancer syndromes. Participants underwent a survey on genetic counseling, genetic testing, and risk management for breast and ovarian cancer under a hypothetical *BRCA1* mutation status. Female participants without prior history of breast cancer were included in this study, since the survey questions on risk management were mostly on breast cancer prevention or early detection. The final survey cohort included 430 women with colorectal cancer, endometrial cancer, or ovarian cancer, diagnosed at relatively young age (< 50), with family history of cancer, or having had more than 2 cancers. None of the participants had known mutation status in any cancer susceptibility genes prior to enrolment. All participants were of Asian ethnicity.

Ethical approval had been obtained from the Institutional Review Board (IRB) of KF-SYSCC before the recruitment of the subjects. Trained research assistants explained the purpose and content of the study and obtained written informed consent from all participants. They then filled out a standardized 2-page questionnaire (with assistance provided by the research assistants whenever necessary). After completing the survey, the participants underwent genetic testing free of charge and were given the option for post-test genetic counseling by a cancer genetics counselor.

Survey instruments

The authors developed a survey that included questions on (1) demographics and personal/ family history of cancer; (2) prior experience with genetic testing, and reasons for considering or not considering genetic testing; (3) perception and attitude towards genetic counseling; and (4) preference on risk management strategies (breast MRI, RRM, RRSO, chemoprevention) under a hypothetical scenario with *BRCA1* mutation. We selected *BRCA1* mutation and cancer risk management for breast and ovarian cancer for survey questions because HBOC is the best known hereditary cancer syndrome and has the best evidence-based risk-reducing strategies.

Agreement to five statements pertaining to the attitude and knowledge towards genetic counseling (1 = strongly

disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree) were validated by performing an exploratory factor analysis with a principle axis factoring, which revealed two factors. Factor 1 related to the functions of genetic counseling service included questions of "genetic counseling would help me decide whether to undergo genetic testing", "genetic counseling would help me decide which type of genetic testing to undergo", and "genetic counseling could explain to me genetic testing report". Factor 2 related to willingness for genetic counseling included questions of "I myself would like to seek genetic counseling", and "I would recommend my relatives or friends to seek genetic counseling". These two factors explained 70% of the variance. The internal consistency of the entire scale was good ($\alpha = 0.80$), with 0.89 for factor 1 and 0.79 for factor 2, respectively. Scores of 1 to 5 for the five statements were added to give a summation score (range 5–25) for each participant, in which higher score indicated more positive attitude and understanding towards genetic counseling.

Data analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS, version 24). Descriptive statistics were computed for the demographic or disease-related variables, predictor and the outcome variables. The outcomes were willingness to consider four different risk management strategies: breast MRI, preventive tamoxifen, RRM, and RRSO. Bivariate analyses were undertaken to explore the associations between the predictor and the outcome variables using Pearson correlation (for continuous variables: age, number of 1st and 2nd-degree relatives with cancer, attitude towards genetic counseling) and Pearson Chi-square test (for categorical variables: education, partnered, working, and history of cancer). For multinomial logistic regression, each outcome variable was recoded into an ordinal variable with three levels (consider/consider under conditions, not consider, not yet decided), with "not consider" as the reference group. Only those predictor variables correlated to the outcome variable with p value > 0.25 from the bivariate analyses were fitted into the multivariate regression model.

Results

Participant demographics

Table 1 summarized demographic and cancer-related characteristics of the participants. Age ranged from 21 to 79 years (mean 48.8, SD 9.6). About two-thirds (63.0%) were married or had partners, over half (55.3%) had above high school education, and over half (55.3%) were working at the time of data collection. All participants had personal history of cancer, among which 39.5% had colorectal cancer, 27.0% had endometrial cancer, and 39.3% had ovarian cancer. Mean age of onset for the first cancer was 44.2 years. Over half (51.6%) the women had 1st-degree relatives with cancer, and 16.3% had 2 or more 1st-degree relatives with cancer.

Knowledge and attitude towards genetic counseling and testing

Only a minority of participants (30.7%) had considered genetic testing (Table 2). Not knowing about genetic testing was the most commonly checked reason (75.3%) for not previously considered testing (Table S1). Similarly, only a minority of participants (28.4%) had known about genetic counseling service. However, when prompted about the services of genetic counseling, the summation score for attitude towards genetic counseling was 19.8 (SD 2.9) out of 25, indicating fairly positive attitude (Table S2).

Attitude towards cancer risk management as a hypothetical *BRCA1* mutation carrier

Among the four cancer risk management strategies for breast cancer or ovarian cancer, breast MRI was the best received. 54.4% would consider annual breast MRI for breast cancer surveillance, while much fewer would consider risk reducing strategies, 24.7% for tamoxifen, 12.6% for RRM, and 27.9% for RRSO (Table 2). The most common reason for not considering breast MRI was its cost, since it is not covered by insurance (Taiwan National Health Insurance). The most common reason for not considering preventive tamoxifen was the potential side effects. The most common reason for not considering the prophylactic surgeries was them being considered too extreme (Table S3).

Factors associated with risk management intentions as a hypothetical *BRCA1* mutation carrier

Women with more positive attitude towards genetic counseling (higher scores) were more likely to consider cancer risk management strategies, especially the non-invasive breast MRI or chemoprevention (Fig. 1, Tables S4, S5).

Breast MRI surveillance

In the univariate analysis, having more positive attitude towards genetic counseling ($p < 0.0001$), having considered genetic testing ($p < 0.0001$), higher education ($p = 0.007$), and younger age ($p = 0.015$) were associated with willingness to consider breast MRI (Table S4).

In the multivariate analysis (Table 3), women who had considered or had genetic testing before (OR 2.99, 95% CI 1.46–6.11), or had higher education > 12 years (OR 1.78,

Table 1 Demographic and cancer-related characteristics (N = 430)

	Number (%)
Age (Mean ± SD/Range)	48.8 ± 9.6/21–79
Married or partnered	
Yes	271 (63.0)
No	157 (36.5)
Missing	2 (0.5)
Education	
< = 12 years	188 (43.8)
> 12 years	238 (55.3)
Missing	4 (0.9)
Working	
Yes	238 (55.3)
No	192 (44.7)
History of cancer	430 (100)
Colorectal cancer	170 (39.5)
Endometrial cancer	116 (27.0)
Ovarian cancer	169 (39.3)
Other cancer	20 (4.7)
Age of the 1st cancer diagnosis (Mean ± SD/Range)	44.2 ± 9.4/16–78
Number of 1st degree relatives with cancer (Mean ± SD)	0.7 ± 0.9
0	208 (48.4)
1	152 (35.3)
2	48 (11.2)
3	20 (4.7)
4	2 (0.5)
Number of 1st and 2nd-degree relatives with cancer (Mean ± SD)	1.8 ± 1.8

95% CI 1.00–3.17) had significantly higher odds of considering breast MRI. Furthermore, with each point increase in the attitude score towards genetic counseling, the odds of considering breast MRI increased by 20% (OR 1.20, 95% CI 1.09–1.32).

Chemoprevention with tamoxifen

In the univariate analysis, having more positive attitude towards genetic counseling ($p = 0.005$), having considered genetic testing ($p = 0.032$), married/partnered ($p = 0.007$), and having had female-specific cancer ($p = 0.018$) were associated with willingness to receive preventive tamoxifen (Table S4).

In the multivariate analysis (Table 3), women who had considered or had genetic testing before (OR 1.79, 95% CI 1.00–3.17) or had female specific cancer (OR 1.98, 95% CI 1.13–3.47) had significantly higher odds of considering preventive Tamoxifen, whereas women who were partnered had lower odds (OR 0.46, 95% CI 0.26–0.79) of considering preventive tamoxifen. With each point increase in the attitude score towards genetic counseling, the odds of considering preventive tamoxifen increased by 11% (OR 1.11, 95% CI 1.02–1.22).

Risk-reducing mastectomy

In the univariate analysis, women with more positive attitude towards genetic counseling ($p = 0.012$), who had considered genetic testing before ($p = 0.004$), with younger age ($p = 0.047$), or who had female specific cancer ($p = 0.042$) were more likely to consider RRM (Table S5).

In the multivariate analysis (Table 3), having considered or had genetic testing (OR 2.24, 95% CI 1.13–4.42) and having had female specific cancer (OR 2.09, 95% CI 1.01–4.35) were associated with significantly higher odds of considering RRM.

Risk-reducing salpingo-oophorectomy

In the univariate analysis, women with more positive attitude towards genetic counseling ($p = 0.040$), or who had considered genetic testing before ($p = 0.009$) were more likely to consider RRSO (Table S5).

In the multivariate analysis (Table 3), only women who had considered or had genetic testing before (OR 2.69, 95% CI 1.27–6.93) had significantly higher odds of considering RRSO.

Table 2 Attitude towards genetic counseling, testing, and cancer risk management (n = 430)

	Number (%)
Considered or had genetic testing before	
Yes	132 (30.7)
No	296 (68.8)
Missing	2 (0.05)
Knew about genetic counseling service	
Yes	122 (28.4)
No	266 (61.9)
Not sure	40 (9.3)
Missing	2 (0.5)
Attitude towards genetic counseling (Mean ± SD/Range)	19.8 ± 2.9/10–25
Breast MRI annually	
Will consider/consider under conditions	234 (54.4)
Will not consider	82 (19.1)
Cannot decide now	101 (23.5)
Missing	13 (3.0)
Preventive tamoxifen (n = 429)*	
Will consider/consider under conditions	106 (24.7)
Will not consider	194 (45.2)
Cannot decide now	125 (29.1)
Missing	4 (0.9)
Risk reducing mastectomy	
Will consider/consider under conditions	54 (12.6)
Will not consider	260 (60.5)
Cannot decide now	108 (25.1)
Missing	8 (1.9)
Risk reducing salpingo-oophorectomy (n = 197)**	
Will consider/consider under conditions	55 (27.9)
Will not consider	91 (46.2)
Cannot decide now	48 (24.4)
Missing	3 (1.5)

*Excluded women who had already received or not suitable for tamoxifen

**Excluded women had already received salpingo-oophorectomy

Discussion

This study explored knowledge and attitude toward genetic counseling, genetic testing, cancer risk management for hereditary breast and ovarian cancer syndrome, and their correlations in women with cancer in Taiwan. We found very limited knowledge of genetic counseling and genetic testing for hereditary cancer in this cohort of women, despite all having personal history of cancer and more than half having family history of cancer in first degree relatives. However, when prompted with possible services genetic counseling could provide, the majority of the participants agreed that genetic counseling could help them understand more about genetic testing and would consider seeking genetic counseling. This finding was consistent with a recent study conducted in Hong Kong that also showed inadequate knowledge in high risk Chinese women with HBOC [11]. Their study found that the opted rate for genetic testing was 100% after genetic counseling which highlighted the importance of genetic counseling and that patient education may help decision making on genetic testing.

The women in our study preferred enhanced breast cancer screening with breast MRI much more than risk reducing interventions. Adding breast MRI annually to routine breast cancer screening would be considered by over half the study participants. This result was consistent with the previous study that showed screening was preferred much more compared to risk reducing surgeries among average risk population [3]. Our study found lower proportion of unaffected women considering prophylactic surgeries than in other studies; but the lower rate of RRM than the rate of RRSO is a trend similar to other studies. In our study, 12.6% of women would consider RRM, and 27.9% would consider RRSO with a hypothetical *BRCA1* mutation. This

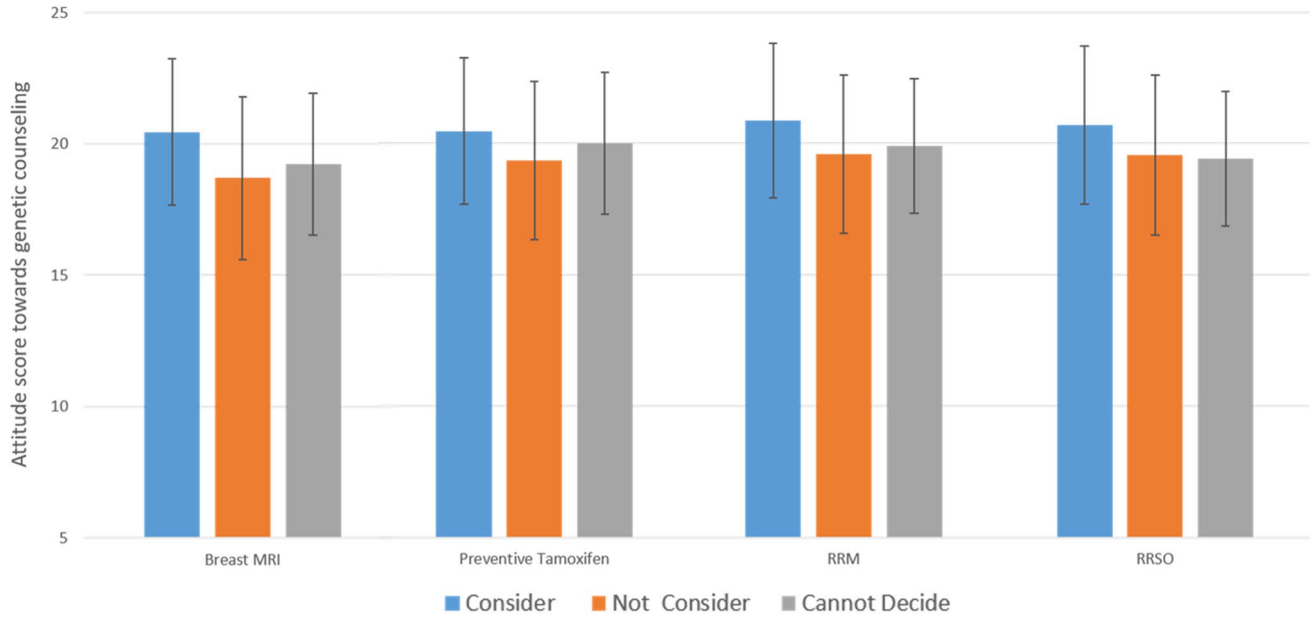

Fig. 1 Comparison of attitude scores towards genetic counseling by intentions for the four risk management strategies

Table 3 Multivariate analysis of factors associated with cancer risk management strategies

Factors	OR (95% CI)	p
Breast MRI		
Considered/had genetic testing	2.99 (1.46, 6.11)	***.003***
Attitude score towards genetic counseling	1.20 (1.09, 1.32)	***<.001***
Age	0.995 (0.97, 1.02)	.728
Education (> 12 years)	1.78 (1.00, 3.17)	***.049***
Preventive tamoxifen		
Considered/had genetic testing	1.79 (1.00, 3.17)	***.048***
Attitude score towards genetic counseling	1.11 (1.02, 1.22)	***.023***
Age	1.00 (0.97, 1.03)	.960
Partnered	0.46 (0.26, 0.79)	***.005***
Had female-specific cancer	1.98 (1.13, 3.47)	***.018***
Risk-reducing mastectomy		
Considered/had genetic testing	2.24 (1.13, 4.42)	***.020***
Attitude score towards genetic counseling	1.12 (0.998, 1.26)	.054
Age	0.98 (0.95, 1.02)	.376
Education (> 12 years)	1.26 (0.62, 2.54)	.520
Partnered	0.59 (0.30, 1.15)	.119
Had female-specific cancer	2.09 (1.01, 4.35)	***.048***
Risk-reducing salpingo-oophorectomy		
Considered/had genetic testing	2.69 (1.27, 6.93)	***.012***
Attitude score towards genetic counseling	1.11 (0.98, 1.26)	.112
Working	0.56 (0.27, 1.14)	.110
Number of 1st and 2nd-degree relatives with cancer	0.85 (0.68, 1.07)	.159

is in contrast to 23.3% for RRM and 42.5% for RRSO among women with at least 10% risk for carrying a mutation [12], and 25.7% for RRM among high risk women [13]. A possible reason for the lower rates may be risk perception [13], since most participants in our study had limited knowledge of genetic testing and had low self-perceived risk of having hereditary cancer. Despite explaining the high cancer risks in a hypothetical *BRCA1* mutation status, the perceived

cancer risk was probably still not high enough for them to consider preventive surgery. Reasons for lower rate for RRM compared to RRSO may include culture and body image issues [14]. One study conducted in Hong Kong found 21.1% of mutation carriers receiving RRM [15]. This was an actual rate after confirmed mutation rather than a hypothetical mutation status; the authors suggested cultural difference making the rate somewhat low compared to other international studies. Cancer is considered a taboo by many Asians, and it is closely linked to the perceived stigma of having an illness, feeling shame, and not wanting to be treated differently [16]. As a result, receiving RRM that involves removing an obvious part of the body may imply an illness and affect body image more profoundly than RRSO.

We found strong association between having considered genetic testing before and willingness to consider all four risk management strategies, as well as strong association between positive attitude towards genetic counseling and willingness to consider non-invasive risk management strategies including breast MRI and preventive tamoxifen. This result provided implication that public awareness and patient education of genetic counseling, genetic testing, and risk management may be helpful for women with hereditary cancer to consider risk management strategies. Genetic counseling can provide appropriate risk perception, counseling on cancer related distress and anxiety, which are known to influence the decision to pursue risk reducing interventions [6, 12, 13].

Our results showed that women with prior history of female specific cancers (endometrial cancer or ovarian cancer) were approximately 2 times as likely to consider preventive tamoxifen or RRM. These women have received salpingo-oophorectomy and may have adapted to their femininity concern. This was consistent with previous studies that showed having undergone RRSO may be a predictor for RRM [14]. Qualitative studies in this area could be explored in the future.

The limitations of this study included that our cohort included only women with history of non-breast cancer, so it may not represent the attitude of those without cancer or with breast cancer. In addition, only *BRCA1* gene was hypothesized in our scenario, the impact of other gene mutation on patients was unknown. Furthermore, over half of the participants had gynecological cancers therefore already had their ovaries removed, their intention to consider RRSO could not be assessed.

Conclusion

Knowledge of genetic testing and positive attitude towards genetic counseling was associated with increased willingness to consider cancer risk management for hereditary breast and ovarian cancer syndrome in women with cancer in Taiwan. Given the limited knowledge on genetic testing and counseling in our population, increasing public awareness of these services may increase the adoption of risk management strategies.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00520-021-06742-4.

Author contribution All authors were responsible and accountable to all part of work related to the study. Specifically, YAW conceptualized the original idea and designed the study. SYF contributed to the conception, analyzed and interpreted the data. LLH and CFH enrolled and surveyed the study participants, and collected the data. FHH and HPP contributed to data analysis. SYF, YAW, and ASY contributed to writing the manuscript. YAW and ASY acquired funding. All authors revised the manuscript and gave approval to the final version to be published.

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Data availability The data that support the findings of this study are available from the authors upon reasonable request. The data are not publicly available due to privacy or ethical restrictions.

Code availability Not applicable.

Declarations

Ethics approval and consent to participate Ethical approval was obtained from the Institutional Review Board (IRB) of KF-SYSCC (2018–03-01A). All procedures involving human participants were performed in accordance with the ethical standards of the institutional and/or national research committee and the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Consent for publication The participants signed informed consent regarding publishing their data and interview content.

Conflict of interest The authors have no conflicts of interest to declare.

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