PH.D. DEGREE IN SYSTEMS MEDICINE
CURRICULUM MEDICAL HUMANITIES
EUROPEAN SCHOOL OF MOLECULAR MEDICINE (SEMM)
UNIVERSITY OF MILAN AND UNIVERSITY OF NAPLES "FEDERICO II"

ONCOGENETIC AND DECISION-MAKING PROCESS. MEN'S ADHERENCE TO CASCADE SCREENING FOR HEREDITARY BREAST AND OVARIAN CANCER SYNDROME

Settore Disciplinare PSI/01

Giulia Ongaro

Tutor: Prof. Gabriella Pravettoni
University Of Milan, Department Of Oncology And Hemato-Oncology

PhD Coordinator: Prof. Saverio Minucci

A.A. 2022-2023

To patients and family members

who made this study possible,

sharing their personal experiences and perspective

Table of content

List of abbreviations

ASE	Action Self-Efficacy
BrRP	Breast Cancer Risk Perception
BRCA1	BReast CAncer 1 gene
BRCA2	BReast CAncer 2 gene
CI	Confidence Intervals
CS	Cascade Screening
CSE	Coping Self-Efficacy
FRM	Family-referred narrative Message
FDRs	First Degree Relatives
FOE	Family-referred Outcome Expectations
GRI	Genetic Risk Information
HAPA	Health Action Process Approach
HCSs	Hereditary Cancer Syndromes
HBOC	Hereditary Breast and Ovarian Cancer
HRA	Health Risk Attitude
INT	Intention
IRB	Institutional Review Board
IU	Intolerance of Uncertainty
MRI	Magnetic Resonance Imaging
PALB2	Partner And Localizer Of BRCA2
PARENT	Parental Status
PaRP	Pancreatic Cancer Risk Perception
PB	Perceived Benefit
PGD	Preimplantation Genetic Diagnosis
PLAN	Planning
PrRP	Prostate Cancer Risk Perception
PSA	Prostate-Specific Antigen
PVs	Pathogenic Variants
RA	Risk Attitude
RCT	Randomized Control Trial
RP	Risk Perception

SE	Standard Error
SRM	Self-referred narrative Message
SOE	Self-referred Outcome Expectations
SDRs	Second Degree Relatives
TPB	Theory of Planned Behavior
TTM	Transtheoretical Model
UMT	Uncertainty Management Theory

Figure Index

Abstract

Introduction. Pathogenic variants occurring in the BRCA1 and BRCA2 genes significantly increase the relative and absolute risks of developing breast, ovarian, prostate, pancreatic cancer, and melanoma. Clinical guidelines advocate for the use of cascade screening (CS) to increase the identification rates of at-risk family members and advance genetically targeted disease prevention. However, despite the benefits of CS, testing uptake is relatively low, particularly in at-risk men, for whom the decision-making process regarding CS appears to be influenced by familial rather than individual disease risk, emphasizing the role of familial obligation. Little is known about the motivational drives and psychological determinants of men's adherence to CS, as well as about factors that hinder or enhance the implementation of CS in at-risk men in BRCA1/2 positive families. **Methods.** A mixed-method study has been developed to explore this understudied theme. Applying the Health Action Process Approach model, a longitudinal RCT study tested a) the effectiveness of two messages in promoting intention to adhere to CS in a sample of at-risk men, and b) a model of relationships on the adherence to CS. Additionally, a qualitative study was designed to explore facilitators and barriers for CS in not-yet-tested men. **Results.** The study found no significant differences in the impact of the two messages on the intention to adhere to CS. However, several noteworthy associations emerged, including links between the intention to adhere to CS and age, parental status, perceived risk of breast cancer, self-referred outcome expectancies, perceived benefits, coping self-efficacy, and planning. Intention was identified as a crucial mediator in the relationship between perceived benefits of genetic testing and planning of the action. From the qualitative study, several factors at the individual and interpersonal as well as provider levels, and a few factors at the environmental level, has been described as barriers and promoting factors to CS for HBOC. **Conclusions.** Our findings offer valuable insights for future interventions targeting at-risk male relatives. Gender-specific educational materials, continued education, and public awareness campaigns highlighting male involvement in HBOC syndrome, their cancer risk, and surveillance strategies are crucial for improving CS uptake. To address the challenges of low uptake, it is essential to explore alternative delivery methods, such as direct approaches where trained providers engage directly with at-risk male relatives, moving beyond traditional patient-mediated methods.

Chapter 1. Introduction

1.1 Hereditary Cancer Syndromes

Hereditary Cancer Syndromes (HCSs) account for approximately 5-10% of all cancers, even though they are often underestimated (Jahn et al., 2022; LaDuca et al., 2020; Mandelker et al., 2017). Genetic variants are the molecular basis of HCSs, and describe DNA sequence variations within an individual's or population's genome able to affect gene expression or functions (Garutti et al., 2023). It is well-established that certain gene variants, known as Pathogenic Variants (PVs), increase the lifetime risk of specific cancer types and often affect multiple organs within individuals or families (Nagy et al., 2004). Specifically, although each syndrome shows highly specific clinical manifestations, the suspicion of inherited cancer susceptibility arises when: a) cancer is diagnosed at an unusually early age, b) two or more relatives from the same side of the family reported the same type of cancer, c) genetically related cancer (such as breast and ovarian cancer) occurred, d) several generations were highly affected by cancers, e) cancer has an atypical sex distribution (for example, breast cancer in a man) (Garutti et al., 2023).

Most HCSs exhibit an autosomal dominant inheritance pattern, meaning that being first-degree relatives (FDRs) of a proband (the first identified affected family member who seeks medical attention for a genetic disorder; Marabelli et al., 2019) gives them a 50% chance of being carriers themselves (Petrucelli et al., 2022).

Genetic testing and analysis enable the identification of individuals genetically predisposed to cancer due to the presence of PVs. The identification of a variant has several profound implications for the clinical scenario of genetically predisposed individuals. First, it allows them to benefit from a tailored preventive program designed to address their increased risk of cancer, such as organ-specific surveillance and/or prophylactic surgeries (Frank, 2001; Roukos et al., 2002). Identifying an HCS can indeed have significant medical management implications, especially for individuals already diagnosed with cancer, allowing the use of targeted therapy and dramatically increasing the therapeutic armamentarium for that patient (Jin et al., 2019; Waarts et al., 2022). Furthermore, every family member may also be tested for searching for the same variant, expanding the identification of at-risk relatives and consequently the benefit of

therapeutic and preventive strategies (Frey et al., 2022).

The most prevalent HCSs are Hereditary Nonpolyposis Colorectal Cancer (HNPCC or Lynch syndrome-LS), and Hereditary Breast and Ovarian Cancer (HBOC) syndrome. LS carriers are mainly at risk of developing colorectal and endometrial cancers, with an estimated lifetime risk ranging from 30 to 70% (Lynch & de la Chapelle, 2003); less frequently, carriers can be affected by other cancers such as gastric, pancreatic, biliary, ovarian, and urinary tract cancers (Taieb et al., 2022).

1.2 BRCA1- and BRCA2-Associated Hereditary Breast and Ovarian Cancer

HBOC syndrome (OMIM 604370, 612555) is a genetic condition primarily associated with germline mutations in two key genes: BRCA1 (BReast CAncer 1 gene) and BRCA2 (BReast CAncer 2 gene), often referred to as BRCA1/2. The prevalence of these PVs in the general population is estimated at 1:400 to 1:500, although it is much higher in certain specific populations due to founder variants (Ashkenazi Jewish descent or Inuit from Ammassalik, Greenland) (Petrucelli et al., 2022). This condition is characterized by an elevated risk of both female and male breast cancer, as well as ovarian cancer (including fallopian tube and primary peritoneal cancers). Moreover, BRCA1/2 carriers are also at a greater risk of developing to a lesser extent other types of cancers, including prostate and gastrointestinal cancers (pancreatic, gastric, biliary tract, esophageal) (Corso et al., 2018; Kuchenbaecker et al., 2017; Nyberg et al., 2020). The BRCA1/2-associated risk for melanoma, colorectal cancer, and lung cancer is currently a matter of debate (Garutti et al., 2023). Since HBOC is an autosomal dominant condition males and females are equally involved in and equally likely to pass on or inherit the mutation, although it exposes them to different risks (Petrucelli et al., 1993).

The risk of developing a specific type of cancer depends on whether HBOC is caused by PV in BRCA1 or BRCA2. The lifetime risk of developing breast cancer is significantly elevated, reaching 60.8% for women inheriting a BRCA1 PV and 63.1% for those inheriting a BRCA2 PV. This is in stark contrast to the 11-13% risk observed in the general population (Bray et al., 2014; Metcalfe et al., 2018). Furthermore, the lifetime risk of breast cancer escalates to 1.2% for male BRCA1 carriers and 8.8% for BRCA2 carriers, compared to the mere 0.1% risk encountered in the general population (Mahon, 2014; Tai et al., 2007). Women with BRCA1 and BRCA2 PVs have a cumulative lifetime

risk of ovarian cancer of 39–44% and 11–17%, respectively (Walker et al., 2019). In regards to men, it is noteworthy that the cumulative lifetime risk of prostate cancer is notably higher in BRCA2 carriers compared to BRCA1 carriers and the general population, reaching as high as 20-25% (M. Daly et al., 2021).

Once a BRCA1/2 PV has been identified, it has several implications for both treatment and prevention strategies. Prophylactic surgeries (such as prophylactic bilateral mastectomy, prophylactic bilateral salpingectomy, or salpingo-oophorectomy) and preventive chemotherapy (e.g., tamoxifen) may be performed to reduce female carriers' risk of developing ovarian and breast cancer; yet, risk reduction strategies for male BRCA1/2 carriers are currently lacking. However, specific surveillance programs have been designed for male and female BRCA1/2 carriers. For females, tailored surveillance programs encompass monthly breast self-examinations, annual or semiannual clinical breast examinations, annual mammography, and breast Magnetic Resonance Imaging (MRI) (Petrucelli et al., 2022). Ovarian cancer screening strategies involve annual transvaginal ultrasound and monitoring serum CA-125 concentrations, with initiation commencing at the age of 35. Male breast cancer screening involves instruction in breast self-examinations and annual clinical breast examinations, typically commencing at age 35. Given their heightened susceptibility to aggressive prostate cancer, proactive prostate cancer screening should commence at age 45, involving annual assessments of serum prostate-specific antigen (PSA) levels and digital rectal examinations (Giri et al., 2020; Petrucelli et al., 2022; Trevisan et al., 2023). For both males and females, the approach to melanoma and pancreatic cancer screening should be individualized taking into account family history, and is not routinely recommended for asymptomatic individuals (Petrucelli et al., 2022). Significantly, in 2023, Lombardy (Italy) implemented new breast cancer patient care guidelines. These guidelines involve extending regional health care co-pay exemptions for breast cancer screening prevention in male BRCA1/2 carriers (Alleati per la Salute, 2023).

1.3 Psychological Implications Associated with the Genetic Risk-Information

The utilization of genetic testing to identify an individual's predisposition to various diseases, including cancer, is on the rise worldwide. Genetic testing provides people with valuable insights into their health and the likelihood of developing certain medical

conditions, such as cancer. Genetic testing for cancer is typically performed in two primary situations:

- Predictive Genetic Testing (Pre-symptomatic Testing): This type of testing is conducted when an individual has not exhibited any symptoms or signs of cancer but has a family history or other risk factors that suggest a HCS or an increased risk of developing cancer in the future. It aims to identify genetic mutations associated with cancer susceptibility before any symptoms occur;
- Diagnostic Genetic Testing: This type of testing is carried out after an individual received a cancer diagnosis. It is used to determine whether the cancer is associated with specific genetic mutations or syndromes, which can provide valuable information for treatment decisions and assessing the risk of cancer recurrence.

Both predictive and diagnostic genetic testing play crucial roles in cancer risk assessment and management (Oliveri et al., 2018).

Genetic Risk Information (GRI) is characterized by its inherent uncertainty, complexity, and probabilistic nature. When individuals receive GRI, it provides insights into their heightened risk of developing a particular disease, but it does not definitively predict whether the disease will manifest, when it might occur, or the specific manner in which it will develop. From a psychological perspective, the perceived certainty or uncertainty related to GRI might affect individuals' beliefs, decision-making processes, and actions (Tormala, 2016). Some individuals may be highly motivated and eager to undergo testing to gain certainty about their health risks, while others may experience anxiety or apprehension associated with the uncertainty that such testing can bring (Hong et al., 2019).

Intense psychological reactions emerge when individuals receive GRI related to serious illnesses, such as a cancer diagnosis. A recent systematic review showed that people tend to be psychologically unprepared to cope with genetic bad news, and reactions depend on the disease category investigated by the genetic testing (Oliveri et al., 2018; Oliveri, Pravettoni, et al., 2016). Concerning the oncogenetic domain, both negative and positive psychological implications arise (Oliveri et al., 2018). Some studies focused on BRCA1/2 PV reported a limited influence of GRI on anxiety and distress levels, without significant difference between carriers and non-carriers (Andrews et al., 2004; Claes et al., 2004) suggesting no adverse psychological reactions after BRCA1/2 disclosure. However, other studies showed higher anxiety levels and negative

psychological outcomes in BRCA1/2 carriers compared to non-carriers (Lodder et al., 2001; Shiloh et al., 2013). In particular, negative psychological aspects included higher levels of distress and anxiety in mutation carriers, compared with non-mutation carriers, due to the perception of an imminent future disease and implications not only for the tested individuals but also their family members (Vos et al., 2012). These aspects were complemented by the sense of guilt over the possible transmission of the mutation to their offspring (Oliveri et al., 2018).

However, literature showed that the detection of a BRCA1/2 PV impacts psychological well-being (in terms of increased distress, and anxiety) shortly after receiving results, while returning to pre-testing levels over time (Hamilton et al., 2009). Generally, longitudinal studies have consistently demonstrated a time-dependent pattern in psychological responses. These studies consistently indicated that levels of anxiety and depression tended to notably decrease within the initial 4 to 6 months following the receipt of test results (Andrews et al., 2004; Arver et al., 2004; Claes et al., 2004), and persisted at lower levels even after several years, thus promoting health-related behaviors, including surveillance actions, for up to 4 (Shiloh et al., 2013).

Genetic testing results disclosure can also increase the perception of personal risk (Claes et al., 2004; Vos et al., 2012), positively impacting perceived self-efficacy and attitude to undergo screenings and checkups (Hamilton et al., 2009; Shiloh et al., 2013). In a study conducted by Seven and colleagues (2021), it was found that some women who underwent genetic testing for cancer risk experienced positive emotions such as hope and relief upon receiving their test results. These individuals appreciated the opportunity to take precautions not only for themselves but also for their family members. Furthermore, they expressed relief in discovering the underlying reason for their cancer and felt a sense of relief in finally finding meaning and an explanation for their family's experiences with the disease.

Concern for the offspring and decisional conflict toward their relatives has been reported in BRCA1/2 carriers (Claes et al., 2004). For example, being a female or male BRCA1/2 carrier can also raise dilemmas about future childbearing or ongoing pregnancy, affecting also reproductive decision-making. Meanwhile, important conflicts can arise also between health preventive programs and personal life projects, such as maternity (Caiata-Zufferey et al., 2014). Literature showed difficult and confusing reproductive issues that BRCA1/2 carriers face if they still are in their childbearing years, due to prophylactic surgeries or the use of oral contraceptives/tubal ligation (Friedman &

Kramer, 2005; Pruthi et al., 2010). A cancer diagnosis and increased awareness of genetic risk can have significant implications for individuals' attitudes and decisions related to various aspects of their lives, including relationships, family planning, and the use of reproductive technologies like preimplantation genetic diagnosis (PGD) and prenatal screening (Hesse-Biber, 2018), and it often prompts important discussions within couples about their shared future, values, and priorities impacting couple's psychological well-being (Ross Arguedas et al., 2020). The experience of undergoing oncogenetic testing can significantly impact an individual's perception of their own body; research has shown that individuals may start to view their bodies as potential sources of danger and fear, leading to increased negative emotions (Jabłoński et al., 2019). Furthermore, when it comes to assessing their own cancer risk, individuals may sometimes both underestimate or overestimate their risk, creating complexity in understanding what it truly means to be at risk for a particular condition (Vos et al., 2012).

Despite concerns for adverse psychological responses (Lerman & Schwartz, 1993), BRCA1/2 carriers appeared to adapt well to the risk information, by implementing general health habits, taking time for themselves and paying more attention to their well-being (Oliveri et al., 2018). An increased attention toward health (personal health consciousness), acquired sense of control over risk factors, and increased self-efficacy in handling negative implications of genetic mutation in carriers compared to non-carrier women have been also reported (Oliveri et al., 2018). In addition, the most frequently observed long-term behavioral effects of genetic testing are a healthier diet and generalized "awareness and attention" toward their health (Oliveri et al., 2021). Engagement in general health habits is expected when supported by a heightened sense of personal risk or a perceived susceptibility to a disease such as cancer. Indeed, BRCA1/2 carriers usually experience fear for their own and relative's life and this personal sense of being at high risk might be considered a motivational drive for the adoption of preventive health behaviors (Spector, 2007).

The psychological burden experienced by individuals appeared to be influenced by their perception of the clinical implications in terms of treatment procedure (Ringwald et al., 2016). Specifically, individuals may experience less psychological distress when they perceive these treatment processes as predictable and understandable, suggesting that providing clear and informative guidance on treatment options and processes can help BRCA1/2 carriers in handling the uncertainty and coping better, by implementing positive changes in their health behavior (Ringwald et al., 2016).

Some psychological mechanisms may be used by carriers or at-risk relatives to regulate reactions to being "at-risk" for cancer. Specifically, Shiloh and colleagues (2009) suggested that people may use motivated reasoning processes as potential strategies to regulate levels of psychological distress that might be associated with the awareness of being at high risk for cancer.

Another critical aspect associated with the GRI is related to the communication of the results with potentially at-risk family members. The process of informing family members of their cancer risk and referring them to oncogenetic counseling may be perceived as a "duty" and a "big responsibility", impacting carriers' distress levels, resulting often in not well-informed relatives. Receiving and transmitting GRI is a difficult task that can be impacted by several variables, such as race, religion, age, gender, comprehension of counseling session material, and intra-family connections and communication. Communication and intra-family relationships can benefit greatly from genetic counseling sessions, in two different ways: a) by improving the understanding of the information that has to be delivered to their family members, and b) by facilitating the dissemination of the genetic counseling findings within families, offering tailored and personalized recommendations that are based on the unique clinical and individual circumstances of each family member (Di Pietro et al., 2020). However, while connecting family members with GRI is important, it is equally crucial to equip them with the necessary skills to take essential next steps and effectively cope with that information (Hamilton et al., 2009). Simply providing genetic information without proper guidance and support may limit the long-term impact of this information on personal, familial, and community health. Individuals and families need to be empowered with the knowledge and tools to make informed decisions and navigate the complexities associated with genetic risk. This approach ensures that the information leads to meaningful actions and positive health outcomes (Hamilton et al., 2009).

The experience of living with a BRCA1/2 PV is significantly influenced by whether an individual has already been diagnosed with cancer and undergone related treatments. In other words, individuals who have faced a cancer diagnosis and treatment may have a distinct perspective and psychological experience related to BRCA1/2 genetic testing compared to those who have not had such a diagnosis, highlighting the complex interplay between genetic risk, personal health history, and psychological well-being in individuals with BRCA1/2 PVs (Meiser, 2005). Cancer-affected BRCA1/2 PV carriers reported higher levels of distress enacting concrete coping strategies compared to the unaffected

counterpart (Reichelt et al., 2004). A very recent systematic review assessing the psychological morbidity in cancer-unaffected BRCA1/2 PVs carriers described, as per affected carriers, a peak of distress immediately after genetic testing results disclosure, with a subsequent decline over the following few months (Isselhard et al., 2023). A positive genetic test result, instead, had no significant impact on depression and quality of life in female carriers, except for the cohort of premenopausal women under 50 years of age, who were less satisfied with their role functioning in life also because family planning often competes with risk-reducing surgical procedures, increasing anxiety and distress in this younger group. Instead, positive body image perception decreased after genetic testing results disclosure combined with changes in sexuality, especially for women who decided for a prophylactic mastectomy. The decision paths of prevention and prophylaxis are neither easy nor linear, in particular for healthy subjects: prophylactic mastectomy with a risk reduction on healthy breasts is accompanied by the risk of surgical side effects, body image changes, and regrets in women who have decided on this solution. In contrast, periodic screening for BRCA1/2 unaffected carriers is potentially accompanied by anxiety, including frequent negative thoughts and feelings (Oliveri et al., 2018).

Certain protective factors have been identified as mitigating distress levels in both mutation carriers and non-carriers over time. These factors included receiving comprehensive pre-test information and educational training, as well as fostering open family communication, particularly through direct exchanges among siblings who have undergone genetic testing. Given these complex issues and the multifaceted effect of decisions, BRCA1/2 carriers seek emotional and social support in addition to medical information from genetic counselors and oncologists, which in this context represent trustworthy information sources for carriers (Makhnoon et al., 2022). Help in managing and coping with BRCA1/2 PVs should be provided also by psychologists, family members, or other PV carriers. Therefore, it is important to ensure psychological support and information strategies based on educating the individual (i.e., educational approach) to cope with the test results complemented with counseling in lay-language, supporting optimal understanding and informed decision making (Lerman et al., 1997).

Although literature is full of evidence concerning psychological aspects in female BRCA1/2 carriers, research on the psychological implications of the BRCA1/2 PV for male carriers is still poor (d'Agincourt-Canning & Baird, 2006; Daly, 2009; Finlay et al., 2008; Hallowell et al., 2005; Rauscher et al., 2018). A longitudinal study showed male

carriers more distressed from testing and less satisfied with testing-related processes than male non-carriers, highlighting increased cancer surveillance, and changes in daily-life habits (Shiloh et al., 2013). Distress persisted for male carriers over the years. Nevertheless, male carriers tend to perceive breast cancer as less impactful in terms of emotional and practical implications, and more treatable compared with non-carriers. Furthermore, results showed a specific role of gender identities (in terms of masculinity–femininity, rather than sex per se) in affecting coping with health risk information and health outcomes.

1.4 Cascade Screening for Hereditary Cancer Syndromes

Cascade screening (CS) is a crucial strategy recommended by clinical guidelines (American College of Obstetricians and Gynecologists, 2018) to identify individuals at risk of carrying cancer-predisposing BRCA1/2 PVs within families. This process involves providing genetic counseling and testing to blood relatives of known carriers in order to identify other family members who may also carry the same PV. The primary goals of CS are to increase the detection rates of at-risk relatives and to facilitate targeted prevention measures for those unaffected by cancer, ultimately reducing the morbidity and mortality associated with HCSs like HBOC syndrome. Specifically, younger and cancer-unaffected relatives are those who can get the widest health benefits in terms of early detection and preventive interventions (O'Neill et al., 2021).

CS has been increasingly designated as an emerging opportunity for population-wide cancer prevention (Kurian & Katz, 2020). In a study conducted by Offit and colleagues (2020), a multiple linear regression model was employed to estimate the time required to identify all 3.9 million individuals in the United States who carry PVs in 18 cancer susceptibility genes. Their findings suggested that it would take approximately 10 years to achieve this goal if 70% of all at-risk relatives, including those who are first-degree, second-degree, and third-degree relatives, underwent genetic testing to identify familial PVs. Furthermore, CS is cost-effective and psychosocially advantageous for both family members identified as PV carriers and non- carriers (Hampel, 2016).
Figure 1 shows the process of genetic counseling and testing.

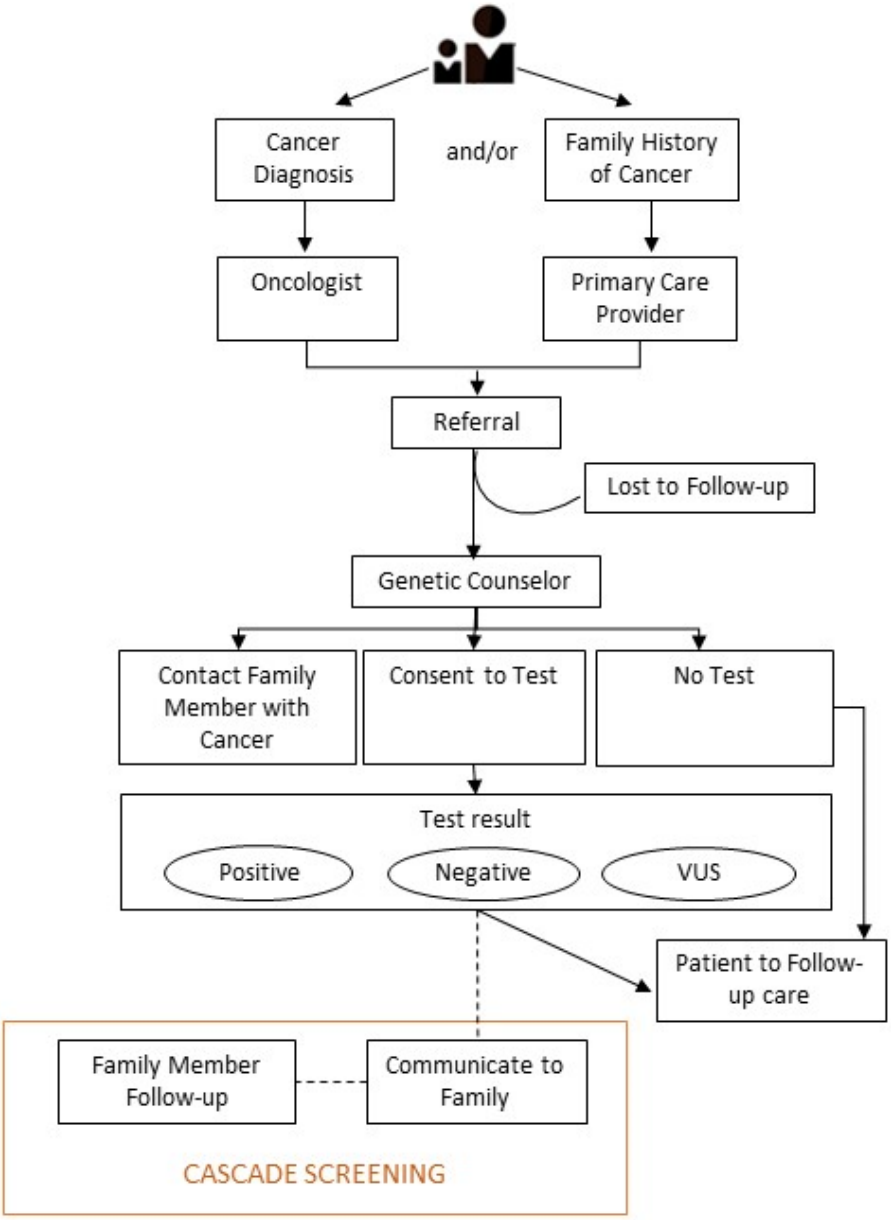

Figure 1. Cascade screening process. Adapted from O'Neill (2021)

Despite the potential benefits of CS in terms of enabling timely risk management, the process of CS can be highly variable, and various issues and challenges in the process could impact its effectiveness in routine clinical practice. The first step requires effective communication of the genetic testing results with potentially at-risk family members, who could have medical implications. Often, in clinical practice, a family letter with details about PV and its implications for family members is used to support the dissemination of positive test results (O'Neill et al., 2021). The degree of closeness and relationship with

one's family member, or the timing of when the results take place may influence the efficiency of the communication itself. Often the identification of a PV in the carrier occurs in conjunction with the cancer diagnosis or during the course of treatment, making GRI a further overwhelming information. In addition, communication may occur at a time when the age of family members does not make this information so relevant to them (very young and/or old family members) limiting the maximization of the effect of sharing genetic information (O'Neill et al., 2021). The level of awareness and understanding of the risk information could be different among family members, impacting the actual implementation of behaviors and coping (Bednar et al., 2020), and it seems there is not a strong correlation between dissemination of risk information and changes in behaviors among informed relatives (Finlay et al., 2008). More in general, the psychological burden of the proband could affect his/her ability and willingness to share health information (Lieberman et al., 2018). Sharing or not sharing health information with other family members is influenced by cultural aspects and ethical considerations that may impact personal attitudes (Suttman et al., 2018). In disclosing germline PV results and encouraging CS, carriers, and relatives face barriers such as accessibility to genetic services, financial constraints, lack of knowledge, but also emotional difficulty (Griffin et al., 2020). A recent systematic review (Srinivasan et al., 2020) identified several individual, interpersonal, and environmental factors that could play a role in CS uptake. Barriers and facilitators identified at the individual level were: a) demographics, b) knowledge level, c) attitudes, beliefs, and emotional responses of the carrier, and d) relatives' responses and attitudes toward CS. At the interpersonal level, barriers and facilitators included a) familial communication, and b) provider-factors. Ultimately, at the environmental level barriers to logistic problems and the accessibility to genetic services were identified. Finally, all these limitations likely contribute to create disparities in both the uptake and provision of genetic services.

A recent review and meta-analysis (Frey et al., 2022) showed that most at-risk relatives do not undergo CS or counseling for HCSs, losing potentially life-saving medical interventions. Specifically, when the risk information was shared by the proband, less than 30% of at-risk FDRs adhered to CS.

Also in the HBOC context, even if disclosure rates are sometimes high, testing rates are relatively low, particularly in at-risk males (Griffin et al., 2020). A Swiss study reported that about 25% of subjects with a family history of HBOC used genetic services, and multivariate analysis identified several factors significantly associated with the

uptake of genetic counseling, including early-onset breast cancer, the presence of female offspring, tumor size, chemotherapy and a relatively short period of time from the cancer diagnosis (Ayme et al., 2014). In a BRCA1/BRCA2 screening study, 48% of healthy Ashkenazi Jewish FDRs and second-degree relatives (SDRs) underwent CS, more commonly performed in FDRs compared to SDRs (58% vs 26%; $p < .05$) and in females vs. males (56% vs 36%, $p < .05$) (Lieberman et al., 2018). Despite very high reported disclosure rates (90%) and free genetic testing for at-risk relatives, results from a study conducted through the University of Pennsylvania (Finlay et al., 2008) showed a substantial lower uptake of CS in general (57%). It was observed that the rates of disclosure regarding genetic test results were similar between female and male relatives; however, there was a notable difference in the uptake of CS between male and female FDRs (73% vs. 49%; $p < .01$) and SDRs (68% vs. 43%; $p < .01$), and among maternal versus paternal lineages family members (63% vs. 0%; $p < 0.01$). These results are similar to those reported by Griffin et al. (2020) where only 40% of FDRs underwent genetic testing, even if carriers' disclosure rate was very high (87% with FDRs). Furthermore, their study supported the idea that female FDRs had significantly higher CS rates compared to male FDRs (59% versus 21%, $p < .001$). They suggested that the low rate of CS uptake among men may indicate that they tend to be less aware that HBOC autosomal dominant mutations are not sex-specific. Trevisan and colleagues (2023) estimated CS uptake in Italy, showing that, overall, about 80% of the relatives who were eligible for BRCA testing did not uptake CS. Uptake remained low among FDRs and SDRs, standing at approximately 30%. Furthermore, results showed that CS uptake for BRCA1/2 PV in Italy was associated with female gender, younger age (< 30 years old), first-degree relationship with the proband, and identification of the PV in the paternal lineages.

Literature indicated a significant gender disparity in the testing rates for BRCA1 and BRCA2 PVs in the United States (Childers et al., 2018). Specifically, the number of women undergoing testing is more than ten times higher than the number of men. This gender difference persists even when considering both affected (individuals with cancer) and unaffected (those without cancer) subjects. It is noteworthy that this gender gap in testing rates cannot be explained by differences in reported family history (no significant difference in the family history of breast cancer between males and females, including early-onset breast cancer, diagnosed at or before age 50, or family history of ovarian cancer). Despite these similarities in family history, women still underwent genetic testing at a significantly higher rate compared to men (Childers et al., 2018).

1.5 Gender Disparities in Cascade Screening Uptake

Gender is undeniably a crucial explanatory variable when seeking to understand health-seeking behaviors, especially within the context of HCSs (d'Agincourt-Canning & Baird, 2006; Graves et al., 2011; Hesse-Biber & An, 2017; Juan et al., 2008; Shiloh et al., 2013) in which specific *"concerns and idealized notions of masculinity"* affect male's responses to health issues (Shiloh et al., 2013, p. 433). However, even if males face BRCA-related cancer risks, the main emphasis in genetic counseling for cancer-related risk remains on females, whereas males do not receive much attention (da Silva, 2016).

Gender-specific barriers have been identified as obstacles hindering at-risk relatives from undergoing genetic counseling and testing (Griffin et al., 2020). A significant contributing factor is the documented disparity in the provision of genetic testing between male and female populations in routine clinical practice. Typically, genetic testing for BRCA1/2 PVs is more readily offered to women, particularly those who have experienced early-onset breast and/or ovarian cancer, or to individuals seeking testing for known BRCA1/2 PVs that have previously been identified within their family. Instead, men are rarely tested as a proband for BRCA1/2 PV. Lately, the guidelines of the National Comprehensive Cancer Network (Daly et al., 2020) have suggested considering patients with pancreatic and prostatic cancers as eligible for genetic testing for BRCA1/2 PV. However, such a recommendation is not yet routine for the test proposal.

Beyond the procedural aspects, several psychological factors have been recognized as potential contributors to lower BRCA1/2 screening rates in men (Daly, 2009; Finlay et al., 2008). The existing literature highlighted that men within BRCA1/2-positive families were less frequently engaged at all stages of the counseling, testing, and communication process, as compared to their female counterparts (Mary Daly, 2009; Finlay et al., 2008; Shiloh et al., 2013). Furthermore, evidence suggested that communication regarding the implications of BRCA1/2 was notably limited between male relatives and female carriers (Roberts, Taber, et al., 2018). Graves and colleagues (2011) proposed that men may encounter unique challenges when discussing their risk of breast cancer with female carriers, particularly because they were often excluded from family discussions concerning familial cancer risk and were not informed by their female relatives about the presence of a PV within the family. Furthermore, men seemed to manage the uncertainty generated by the familial risk status using distancing and avoidant

coping strategies, which allow them to maintain an emotional balance and reduce distress levels due to the risk information (Lodder et al., 2001; McAllister et al., 1998). Men expressed more general difficulty in discussing positive BRCA1/2 results with relatives, compared to their female counterparts, while women reported higher levels of emotional distress associated with the dissemination of the results, compared to men (Finlay et al., 2008). Additional studies highlighted that men within HBOC families frequently experienced self-health concerns and a heightened fear of cancer when contemplating genetic testing (P. Daly et al., 2003; McAllister et al., 1998; Strømsvik et al., 2011).

The low CS uptake in men can also be influenced by socio-cultural factors and gender roles associated with the perception that BRCA1/2 mutations are primarily linked to breast cancer in women. This perception may lead to the misconception that HCSs like HBOC and BRCA1/2 PVs are predominantly a "female matter" (McAllister et al., 1998). Part of this misunderstanding comes from the inaccurate belief that the PV is passed only from mothers-daughters. Recently in this regard, Pritchard (2019) suggested that the HBOC syndrome should be renamed (e.g., to “King Syndrome” from the name of the scientist who discovered BRCA1 PV) removing any reference to gender specification, to solve the misconception that the associated cancer risks affect only women. Changing “HBOC” to “King Syndrome” could have immediate benefits, helping affected and unaffected patients to understand that the cancer risk is not limited to breast and ovarian cancer, facilitating the communication among at-risk family members but also helping healthcare providers and researchers in the evolution of scientific knowledge (Pritchard, 2019). Specifically, syndromes similar to HBOC could be caused by mutations in other genes than BRCA1/2, PALB2 for example (Partner And Localizer Of BRCA2), and the new name could help researchers in linking different genes to the syndrome as scientific progress proceeds. Sometimes clinicians' low levels of knowledge and awareness of HBOC status represented a barrier to men’s involvement in CS (Mersch et al., 2015). Furthermore, the aspect of the social stigmatization that men may encounter after a PV is detected has been found as one obstacle to men’s decision-making process, impacting their willingness to discuss the risk information with other family members (Rauscher et al., 2018; Strømsvik et al., 2010).

1.6 Factors Influencing Genetic Testing Decisions

A small amount of preliminary qualitative research suggested that the reasons why

men and women choose to undergo genetic testing are similar and specifically connected to a) concerns for the next generation, b) a desire to learn more about their health conditions, c) the need to gain information to facilitate decisions about how to manage the risk, d) the degree of self-awareness of risk and the level of anxiety about cancer risk, e) the sense of obligation by one's own family, f) the need to obtain risk information for relatives, especially daughters, and f) to inform reproductive decisions (Daly, 2009; Hallowell et al., 2005). A social constructionist viewpoint posited that psychosocial factors, such as feelings of vulnerability, the perception of social support, and the sense of guilt, drive women's decisions about BRCA1/2 genetic testing and that the fear of passing the BRCA1/2 PV to children makes women more inclined to undergo the genetic test and, eventually, the risk-reducing surgery (Hesse-Biber & An, 2016).

Nonetheless, certain studies that have exclusively examined men's experiences unveiled a recurrent theme wherein men often perceive their decision to undergo BRCA1/2 genetic testing as a familial duty or a responsibility to their offspring (P. Daly et al., 2003; Hesse-Biber & An, 2017; Lodder et al., 2001; Strømsvik et al., 2010). This perspective frames the decision regarding genetic testing for BRCA1/2 as a family-oriented matter rather than an entirely individualistic choice, suggesting a preference for a less individualized approach. Concerns about daughters' health has been described in male BRCA1/2 carriers being more important than personal health concerns, confirming the idea that men could search for the uptake of CS for the sake of their daughters (Hesse-Biber & An, 2017; Peshkin et al., 2021; Shiloh et al., 2013). Based on the Uncertainty Management Theory (Brashers et al., 2001) how individuals appraise, or make sense of, their BRCA-related cancer risks influences the decision they make regarding their genetic testing. Rauscher and colleagues (2019), applying this theory and analyzing qualitative data from tested and not-tested men in BRCA-positive families, showed that men often tended to appraise their uncertainty as irrelevant, implying that they were less likely to actively seek information and did not engage in genetic testing. However, in their study, men always appraised familial uncertainty as dangerous and when this occurred different outcomes could be noted: they sought information for family members, and they were more likely to seek genetic testing both for themselves and for family members. Males' decisions regarding CS have been observed to be primarily focused on familial rather than individual disease risk (Hesse-Biber, 2018), thereby linking the decision to sense of family duty (Rauscher et al., 2019). However, it is important to note that the results discussed were primarily based on data from tested male BRCA1/2 carriers (Hesse-Biber,

2018; Hesse-Biber & An, 2017; Peshkin et al., 2021; Rauscher et al., 2019; Shiloh et al., 2013). This means that the findings may not fully represent the perspectives and decision-making processes of men who have not yet undergone or are still deciding to undergo genetic testing for BRCA1/2 PVs.

1.7 How to Inform Men about BRCA1/2 Genetic Testing

A low level of men's knowledge regarding *BRCA1/2* PV was found as one of the major challenges in this field (Skop et al., 2018). Even when there is males' motivation to obtain more information about the possibility of undergoing genetic testing and uptake CS, few BRCA1/2 education materials that address males' unique needs and concerns are available, considering that the majority of the material is tailored to female needs (Peshkin et al., 2021). Once genetic counseling was performed, the rate of testing results was the same for men and women (Finlay et al., 2008), so it is crucial to identify a way to give proper information to men (gender-specific educational resources). Identifying strategies to increase men's participation in cancer genetic screening is a priority. Recently, alternative forms of service delivery models for genetic counseling have been developed (such as telemedicine with phone or video consults, or web-based platforms) to reply to the increased demand and patient preferences, moving beyond the standard clinic-based genetic counseling (Buchanan et al., 2016; Peshkin et al., 2021). To address barriers that men may face related to BRCA1/2 genetic counseling and testing, Peshkin and colleagues (2021) developed a web-based intervention to educate untested men about the relevance of the BRCA1/2 genetic testing for them; the contents included: a) BRCA overview, b) implications of BRCA1/2 genetic testing for men, c) implications for other relatives (including children), c) an overview of genetic counseling and testing options.

Research has identified several communication strategies that could be useful in increasing health behaviors. Specifically, the use of narrative approaches has been widely shown to be a promising strategy for promoting the enactment and engagement in health behaviors, and health behavioral intentions (Braddock & Dillard, 2016; Hinyard & Kreuter, 2007) including disease prevention and detection behavior such as cancer screening participation. The narrative might be considered as *" any cohesive and coherent story with an identifiable beginning, middle, and end that provides information about scene, characters, and conflict raises unanswered questions and provides resolution"* (Hinyard & Kreuter, 2007). The use of narratives leverage people's affinity for

storytelling and engage them by presenting information in a narrative form; stories have the power to capture people's attention, immerse them in the plot, and make them less likely to notice or reject counter-attitudinal information (information that contradicts their existing beliefs or attitudes) (Jensen et al., 2014). However, although the efficacy of narrative approaches has been shown also in increasing adherence to cancer screening (Ainiwaer et al., 2021), its application to improve men's uptake of CS for BRCA1/2 PVs has not been thoroughly explored, representing a gap in current research and health communication strategies.

Chapter 2. Theoretical Background and Research Questions

2.1 Theoretical Model of Health Behavior Change

Numerous theories in the fields of health psychology and behavioral medicine have been developed to help explain why individuals engage in healthy preventive behaviors. These theories aimed to understand and predict the adoption of health-related habits, the maintenance of these behaviors, and the factors influencing changes in health behaviors over time. Two categories of theory can generally be identified: a) continuum models or b) stage models (Lippke & Ziegelmann, 2008). Continuum models tried to identify influential predictor variables (such as intentions or attitudes) for behavior change, combining them within one prediction equation to be able to place individuals along a continuum of behavior likelihood and to predict the likelihood of that specific behavior. Within this framework, the intervention's goal was to help people move along this route toward action, enhancing the weight of each model-inherent variable (determinants) in all individuals. One of the most popular theories, based on the continuum model, is the Theory of Planned Behavior (TPB), developed by Icek Ajzen as an attempt to predict human behavior (Ajzen, 1991). The TPB outlines several determinants that can significantly influence an individual's behavioral intention, which, in turn, is a direct precursor to the contemplated actual behavior. These determinants encompassed the personal attitude toward the behavior (in terms of behavioral beliefs and outcome expectancies), subjective norm (the social pressure or influence an individual perceives from their social environment, such as friends, family, or peers, regarding the behavior in question), and perceived behavioral control (similar to Bandura's concept of self-efficacy, it reflects an individual's perception of their ability to effectively perform the behavior; Bandura, 1997). The stronger the intention, the greater the likelihood that the individual will indeed carry out the behavior. This theory provided a comprehensive framework for understanding and predicting human behavior, taking into account not only personal attitudes and beliefs but also social influences and perceived control over the behavior.

On the contrary, stage models assumed that behavior change occurred in several discrete steps (or stages), which were used to classify people's stages of change.

Depending on the stage a person was in, some socio-cognitive factors become more important than others. The identification of different stages allowed 'stage-matched' interventions to be developed, giving the possibility to identify relatively homogeneous target groups and therefore also the ones that could be considered as "the most likely to change", targeting interventions accordingly to maximize effectiveness. One of the most commonly applied theoretical and clinical frameworks in the healthcare domain is the Transtheoretical Model (TTM), originally formulated by James Prochaska and Di Clemente (Prochaska & Di Clemente, 1982), which outlines a structured approach to understanding and facilitating behavioral change and identifies five distinct stages of change: a) pre-contemplation (the person does not manifest motivation to change); b) contemplation (the person is thinking about it, may change within the next 6 months); c) preparation (the person is actively planning to make a change in the immediate future); d) action (the person is making a change); e) maintenance (the change has occurred for 6 months or more). It is essential to recognize that the time individuals spend in each stage can vary significantly from person to person, some individuals may progress through the stages relatively quickly, while others may remain in one stage for an extended period. This variability is influenced by various factors, including an individual's readiness, motivation, external support, and the complexity of the behavior being addressed. However, the tasks required to move from one stage to the next are indeed universal in the sense that they represent common processes involved in behavior change. For example, moving from the pre-contemplation stage to the contemplation stage requires becoming aware of the problem. The TTM has been used in several health contexts, including smoking behavior, alcohol abuse, and other forms of addictions (Prochaska et al., 1992), weight control and exercise acquisition (Mastellos et al., 2014), to preventive measures such as medical check-ups (sunscreen use, mammography and/or cancer screening; Spencer et al., 2005).

However, both continuum and stage models presented strengths and weaknesses. In summary, the traditional continuum models have been criticized particularly because of the frequent failure of intention to predict behavior (intention-behavior gap) but these models are considered valuable for predicting behavior and identifying factors that influence it. On the contrary, stage of change models are more useful for tailoring interventions to an individual's stage of readiness for change, yet are often perceived as not-complete in giving explanations.

2.2 The Health Action Process Approach

The Health Action Process Approach (HAPA), developed by Ralf Schwarzer (Schwarzer & Luszczynska, 2008), can be considered a hybrid model with both a continuum as well as a stage layer. The HAPA is a conceptual model designed to elucidate the dynamics of adopting and sustaining health-related behaviors. This model discerns two distinct phases: the pre-intentional motivation process, which culminates in the formation of a behavioral intention, and the subsequent post-intentional volition process, responsible for translating that intention into actual health behaviors. Within each of these phases or stages, distinct patterns of social-cognitive predictors may emerge, influencing the progression from intention to action. *Figure 2* shows the entire model.

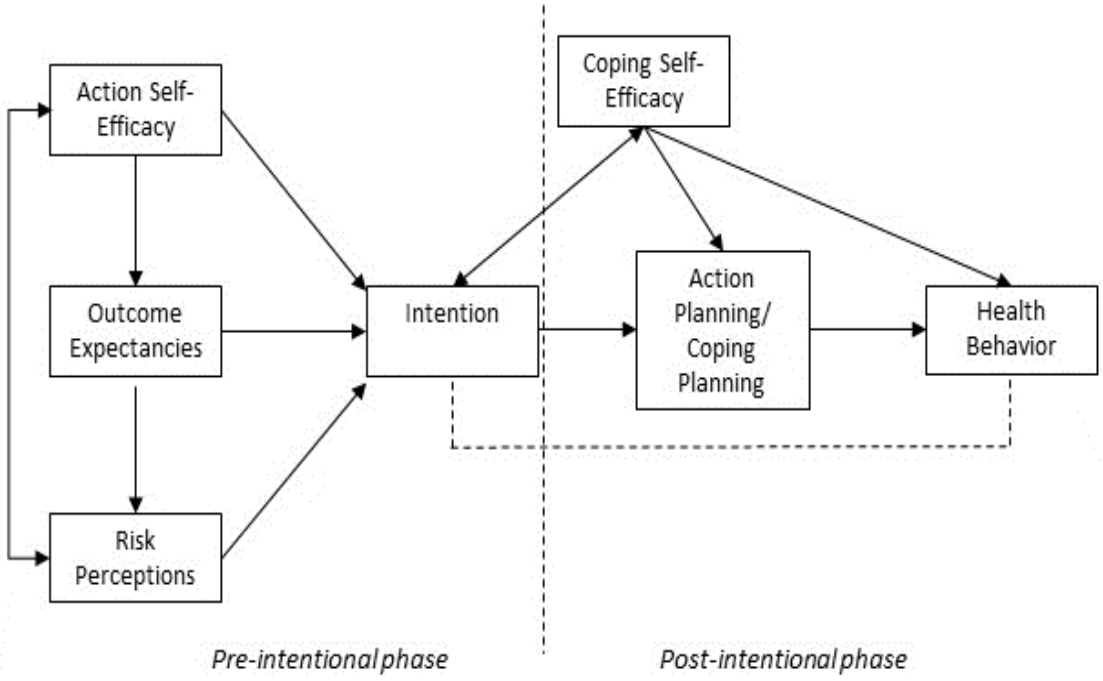

Figure 2. The Health Action Process Approach (retrieved from Schwarzer, 2008)

In the pre-intentional motivation phase (i.e. motivation phase) risk perception, outcome expectancies, and action self-efficacy act as predisposing factors that lead to forming an intention to adopt a precautionary behavior or to change a risk behavior. Self-efficacy and outcome expectancies are seen to play a crucial role in the prediction of the intention, operating in concert. According to Bandura (1997), self-efficacy can be

conceptualized as individuals' beliefs in their ability to control difficult demands and in their performance, and it refers to an optimistic belief ("I am able to eat healthy food, give up junk food"). People with high levels of perceived self-efficacy imagine success and predict potential outcomes. Less confident people imagine failure, doubt themselves, and tend to procrastinate. Outcome expectancies encompass the anticipated advantages and disadvantages, consisting of both positive and negative expectations, that are intrinsic to rational decision-making regarding whether engaging in a health behavior will yield the desired outcome. These expectations can also take the form of more abstract mental representations infused with emotions, such as the belief that "If I maintain a healthy diet, I can lower my risk of developing cancer." Both self-efficacy and outcome expectancies are considered pivotal factors in the formation of an intention to embrace a particular health behavior. Furthermore, risk perception refers to the beliefs and awareness regarding their own risk or susceptibility to a specific disease or situation ("I am at risk for cancer"). The perceived risk can come from a comparison with similar others (also called relative risk perception or comparative risk perception, e.g. "Compared to others of my age and sex, my risk of getting prostate cancer is low/medium/ high") or from objective data (also called absolute risk perception, e.g. "The likelihood that I will get cancer is low/medium/ high"). Furthermore, risk perception has two components: the perceived severity of a health condition and personal vulnerability toward it (Schwarzer, 2016). However, by itself, it is insufficient to generate an intention, but it can be considered a distal antecedent of the behavior, that is necessary to set the subject in a contemplation phase. According to the HAPA model, the intention to adopt a health behavior could be considered as a middle-level mediator between the motivation factors and the volition factors. Good intentions do not always translate into behavior, and for this to happen intention must be transformed into detailed instructions on the desired action. The post-intentional volition factors are useful to overcome the intention-behavior gap (Sutton, 2008); they are the most proximal predictors to actual behavior, and specifically planning (in terms of action planning and coping planning) is specified as a mediator of the intention–behavior relationship. Action planning involves the strategic process of determining the specific details of when, where, and how to execute a particular action or behavior. On the other hand, coping planning revolves around devising alternative behaviors and strategies to effectively navigate and overcome potential obstacles or challenges that may arise during the execution of a planned action. Furthermore, the planning of the action needs to be supported by the coping self-efficacy

(also referred to as maintenance self-efficacy), an optimistic belief about individuals' confidence in their ability to persist and continue their desired behavior over time, despite potential hindrances.

The basic assumption of the HAPA requires that individuals pass through several phases to achieve the desired outcomes (behavior change or adoption); based on these premises, interventions will be all the more effective the more tailored to the characteristics of individuals at that specific stage of change. The effectiveness of HAPA-based intervention is also supported in randomized controlled trials (Mak et al., 2015; Zarski et al., 2018).

2.2.1 Effectiveness of the Health Action Process Approach in Health Contexts

The Health Action Process Approach (HAPA) model has found application in research across numerous health contexts and a diverse range of health behaviors. Its utility has been demonstrated in various studies, highlighting its effectiveness and efficacy as a valuable framework for understanding and promoting health-related behaviors (Zeidi et al., 2020; C. Q. Zhang et al., 2019). A meta-analysis of studies that employed the HAPA within various health behavior contexts revealed consistent findings. The analysis demonstrated small to medium-sized effects, indicating that outcome expectancies and action self-efficacy play mediating roles in the formation of intentions, which, in turn, influence the actual implementation of health behaviors (C. Q. Zhang et al., 2019). Additionally, the analysis found a small effect of risk perceptions on health behavior. These results underscored the significance of self-efficacy in predicting the execution of health behaviors, spanning both the motivational and volitional phases of the HAPA model (C. Q. Zhang et al., 2019). Numerous studies provided compelling evidence for the effectiveness of the HAPA model in predicting physical activity across various groups of individuals, such as inactive middle-aged women (Barg et al., 2012), obese adults (Hattar et al., 2016; Parschau et al., 2014), students (Scholz, Keller, et al., 2009), people with chronic disease like multiple sclerosis (Chiu et al., 2011) or schizophrenia (Arbour-Nicitopoulos et al., 2014). Other studies have found the HAPA to be a useful model in changing behaviors for preventing/managing chronic disease (Smith et al., 2014). Several studies supported the utility of the HAPA model in comprehending

and crafting interventions for smoking behaviors (Radtke et al., 2012; Scholz, Nagy, et al., 2009; Schwarzer & Luszczynska, 2008). The HAPA model has also been found to fit data for predicting dietary behaviors, for example in coronary and hypertensive patients (Steca et al., 2015; Teleki et al., 2018), multiple sclerosis patients (Chiu et al., 2011), or University students (C. Zhang et al., 2018).

Recently, the success of the HAPA model has also been demonstrated in cancer-related screening behavior. Specifically, one recent study tested the theoretical fit of the model for bowel cancer screening, developing interventions able to increase participation rates (Myers et al., 2022). Another study tested the model for predicting diagnostic mammography among women over 40 years old in Iran, showing a prediction rate of about 60% (Pourhaji et al., 2021). In their study, and according to the model, higher risk perception for breast cancer and outcome expectancies with the screening, as well as higher action self-efficacy predicted intentions, and planning of the action. An integrated model built upon the foundations of the HAPA model has demonstrated its effectiveness by leveraging constructs from the motivational phase to predict colorectal cancer screening intentions. In doing so, this model has successfully explained approximately 36% of the variance in behavioral intention for colorectal cancer screening (Maheri et al., 2022). Furthermore, the HAPA model has been used also to find the predictors of cancer-related screening behaviors in the oncogenetic domain, testing its applicability and relevance in this crucial area of health promotion and cancer prevention. Specifically, Annoni and Longhini (2022) tested the HAPA to identify the predictors of men's uptake of genetic testing for BRCA1/2 PV. The participants were men belonging to the general population, and the presence of a PV in BRCA1/2 in family members has not been investigated. Results showed associations (but not the prediction) of self-efficacy and risk perception with the intention to undergo genetic testing, as well as having offspring. Those studies provided partial evidence regarding the efficacy of the HAPA model in elucidating the processes involved in both initiating and maintaining specific health preventive behaviors.

2.3 Attitudinal Factors Influencing Decision-Making in Health Context

Together with the principles of the HAPA model, literature suggested that other attitudinal factors may explain the decision-making process for health behaviors, such as

undergoing BRCA1/2 genetic testing: intolerance of uncertainty and health risk attitudes (Oliveri et al., 2018). As noted earlier, when people face potential health threats, the degree of perceived certainty or uncertainty about the threat could affect subsequent decisions and behaviors. Two different kinds of uncertainty are faced in considering the possibility of undergoing genetic testing: a) the proximal uncertainty due to the result of the genetic testing itself; and b) the distal uncertainty depending on the own personal risk of developing cancer, if a PV is found. How an individual manages this uncertainty could affect his/her intention to undergo genetic testing (Oliveri et al., 2021). Intolerance of Uncertainty (IU) is a personality trait that defines persons who are unable to deal with the negative feelings generated by a perceived lack of appropriate knowledge or by a problem with multiple solutions (Carleton, 2016). Some studies looked at the association between IU and the intention to undergo medical screening, such as cancer-related screening (Taber et al., 2015; Tan et al., 2016). Tan and colleagues (2016) showed IU as a significant predictor of anxiety in men who undergo active surveillance for prostate cancer. Within the context of lung cancer screening, a qualitative study delved into how patients respond to various categories of screening-associated uncertainty (Schapira et al., 2016). Interestingly, the findings revealed that some participants opted to undergo lung cancer screening and additional tests as a means to diminish their uncertainty. In contrast, others decided to decline testing altogether in an effort to preemptively avoid the uncertainty that could arise from potentially ambiguous or inconclusive screening results (Schapira et al., 2016). The results from this study elucidated two distinct dimensions of IU:

- the desire for predictability signifies an active and proactive approach to managing uncertainty. Individuals exhibiting this dimension are inclined to seek as much information as possible about a perceived threat to restore a sense of balance and control;
- the uncertainty paralysis represents an avoidance strategy in response to uncertainty. Individuals characterized by uncertainty paralysis experience an inability to take action due to the overwhelming nature of uncertainty, leading to a state of inaction or indecision (Carleton, 2016).

Literature showed high correlation levels between IU and the search for medical information or adherence to medical screening programs; individuals could be encouraged to search for threat-related material by the need to eliminate uncertainty (Rosen et al., 2007).

Furthermore, people differ in their risk attitude (RA) that is their willingness to take risks. There is no consensus about whether people's attitude toward risk is context-dependent and may differ based on the specific domains, or whether it can be considered as a trait, stable in different domains (Huls et al., 2020; Mata et al., 2018). Weber (2002) suggested that people's attitudes to take risks may be stable in different domains but their risk perceptions may differ depending on the domain. Medical decisions often include a certain amount of risk or uncertainty and health RA could be considered a key determinant of the decision-making process in a health-related context, affecting preventive behaviors (e.g., medical screening, physical activity, diet, or vaccination), unhealthy behaviors (e.g. smoking), and risky behaviors (e.g., surgery) (Van Osch & Stiggelbout, 2007). A recent study analyzed the relationship between RA and healthcare utilization, revealing interesting findings (Lutter et al., 2019). The study observed that individuals who exhibited a greater willingness to take risks were less inclined to utilize healthcare services. This reduced healthcare utilization encompassed various aspects, such as fewer visits to physicians and a lower likelihood of taking prescribed medications. Conversely, the study found that individuals who displayed a lower willingness to take risks tended to have higher levels of healthcare utilization. This higher utilization included more frequent visits to healthcare professionals and a greater likelihood of adhering to medical prescriptions. These results were confirmed also about preventive services (screening behaviors). These findings suggested a potential connection between an individual's risk-taking behavior and their healthcare-seeking patterns. It implies that more risk-averse people may be more proactive in seeking medical attention and adhering to treatment recommendations, while those with a higher propensity for risk-taking may be less inclined to engage with healthcare services.

2.4 Introduction to Research Studies and Aims

Our understanding of the decision-making process regarding preventive screening, including genetic testing for HBOC syndrome, among at-risk men within BRCA1/2 positive families remains limited. This knowledge gap is compounded by the gender disparity observed in CS adherence within the HBOC syndrome context. Furthermore, the scarcity of studies centered on men's experiences and the absence of tailored information addressing the unique needs of men concerning their BRCA1/2-related

cancer risks present an essential and noteworthy case study. Identified gaps in the existing literature underscore the presence of several pertinent research questions that remain unexplored. Among these, three of the most noteworthy research inquiries are:

- What are the most effective motivational factors that can be employed to inform and encourage at-risk men to adhere to CS for BRCA1/2 PVs?
- Which psychological determinants play a significant role in influencing at-risk men's decisions to adhere to CS for BRCA1/2 PVs?
- and in a broader context, what are the barriers and facilitators that may impact men's decisions regarding adherence to CS for BRCA1/2 PVs?

As of now, there is a noticeable gap in the literature when it comes to studies that employ a robust theoretical foundation to systematically investigate the psychological variables that influence men's informed decisions regarding genetic testing for BRCA1/2 PVs. Additionally, there is a dearth of research on the most effective communication strategies to inform men's decision-making in this context. Furthermore, no studies have explicitly aimed to enhance the understanding of the factors that either impede or facilitate the implementation of CS among at-risk men.

This Ph.D. thesis can be considered a contribution to knowing more about these understudied themes. Therefore, a mixed-method research study has been developed to reply to the three research questions. The use of a mixed scientific methodology can provide broader perspectives than those offered by monomethod designs, and it is widely used in healthcare research as a framework for a specific research issue to be addressed using quantitative and qualitative methods and data (Azorín & Cameron, 2010; Smajic et al., 2022). Firstly, applying principles of the HAPA model, a longitudinal quantitative Randomized Control Trial (RCT) study tested a) the effectiveness of two different tailored messages (focused on individual- or familial-drives, respectively) in promoting intention to adhere to CS, and b) a model of relationships on the adherence to BRCA1/2 CS guidelines in a sample of at-risk men FDRs of BRCA1/2 carriers. The results from this RCT study were able to satisfy both the first and the second of the primary aims, that is reply to the first and the second research questions. Secondarily, a qualitative study was designed to explore facilitators and barriers for CS in not-yet-tested men. Starting from the theoretical background of the HAPA model and a multi-level perspective of barriers and facilitators in CS, this study further explored the level of knowledge and decision-making process about CS in male FDRs of female BRCA1/2 carriers.

To sum up, Chapter 3. and Chapter 4. will show the RCT quantitative study and

the qualitative study, respectively. Since the included studies had different samples, methods, statistical analyses, and results, the Discussions will directly follow each Results section. However, a final discussion will be presented in Chapter 5. to bring together the results of the two studies and draw informative conclusions, both for scientific research and clinical practice. Understanding factors that influence the decision-making process about BRCA1/2 genetic testing for men in BRCA1/2 positive families will be critical to designing effective interventions to improve CS for this understudied at-risk population.

Chapter 3. Motivational drives and psychological determinants of men's adherence to CS: a quantitative study

3.1 Introduction

Over 10 times more women than men were tested for BRCA1 and BRCA2 PVs in the U.S., although men faced also some risk, albeit to a different extent than women and for different organs (Childers et al., 2018; Pritchard, 2019). PVs in the BRCA1 and BRCA2 genes increased the relative and absolute risks of breast, ovarian, and other cancers, such as prostate and pancreatic cancer (Corso et al., 2018; Petrucelli et al., 2022). Since both genes showed autosomal dominant expression and may be inherited from the maternal or the paternal side (i.e., both men and women may be carriers), relatives of a BRCA1/2 carrier were exposed to a higher risk of being carrier themselves, and specifically the risk increased as the degree of kinship was approached (for example, FDRs have 50% chance of having the PV, SDRs 25% chance, and so on).

CS (or cascade testing) is used to increase the identification rates of at-risk relatives who in turn will then be able to implement primary and secondary disease prevention (O'Neill et al., 2021). However, despite the benefits of CS in terms of allowing to pursue appropriate regular cancer screening and risk-reduction strategies, less than half of at-risk first-degree family members adhere to CS, and testing rates are relatively low, particularly in at-risk males (Griffin et al., 2020).

Literature showed that several environmental, psychological, and sociocultural barriers may interfere in men's decision-making process about CS. Literature suggested that the decision to adhere to CS for men is usually related to concerns for the offspring and is frequently perceived as a family duty or an obligation towards their children (P. Daly et al., 2003; Hesse-Biber & An, 2017; Lodder et al., 2001; Strømsvik et al., 2009). Rauscher and colleagues (2019) investigated how men approach the individual and familial uncertainty management processes associated with BRCA1/2 PV. The authors applied the Uncertainty Management Theory (UMT; Brashers et al., 2001) that treats the uncertainty attributed to ambiguous and unpredictable situations, such as those linked to cancer-related risk management. According to the UMT, how individuals appraise or

make sense of their BRCA-related cancer risks influences the decisions they make regarding their health. In this qualitative study, researchers discovered that men tended to perceive their individual uncertainty regarding BRCA mutations in two distinct ways: some saw it as irrelevant, while others viewed it as potentially dangerous. This perception of uncertainty played a significant role in their decision-making regarding genetic testing. For those who considered the uncertainty as irrelevant, they were less inclined to actively seek information or undergo genetic testing. This suggested that they may underestimate the importance of knowing their genetic risk. On the other hand, those who viewed the uncertainty as potentially dangerous may have been more motivated to seek information and consider genetic testing. Interestingly, the study also found that a family-focused approach appeared to be the most beneficial for men. Men appraised familial uncertainty as dangerous and that leads to different outcomes: they seek for information for family members and they seek tests for themselves and for family members. They feel themselves as to be more involved in the family decision-making and this is linked to a higher satisfaction with their decisions and positive feelings of closeness with family members. This suggested that emphasizing the potential impact of genetic testing on their family's health and well-being could be a key motivating factor for men to engage in testing (Hallowell et al., 2005; Rauscher et al., 2019). However, these results were based mainly upon data from already tested and BRCA1/2 positive men, thus dealing with men who have undergone a genetic counseling session, and it is unclear if not tested men can differ in the comprehension of the GRI about cancer and decision-making process in the healthcare domain. Indeed, little is known about the motivational drives that may support adherence to CS specifically in a sample of high-risk men.

Narrative strategies to promote health behavioral intentions

One of the primary contributors to the low rate of BRCA1/2 genetic testing is the insufficient awareness and understanding of the significance of testing, coupled with a lack of knowledge about how to access genetic counseling and testing services (Roberts, Dotson, et al., 2018; Srinivasan et al., 2020). Health communication researchers have documented the efficacy of narratives for promoting health behavioral intentions, compared to a non-narrative approach (Braddock & Dillard, 2016; Zebregs et al., 2015). Although narrative approaches showed efficacy in promoting health behaviors and increasing adherence to cancer screening, their utility for improving men's CS uptake remains unexplored. Narrative perspective or point of view is a fundamental story feature

that changes how narratives are delivered to audience members. First-person narratives are told from the protagonist's perspective, sharing emotions and inner thoughts experienced in the course of the narrative event. On the other hand, third-person narratives are narrated by an external observer and the narrator may or may not describe the protagonist's inner thoughts and emotions (van Peer & Maat, 2001). First-person narrative messages were demonstrated to be more effective than third-person narrative messages in promoting self-identity and assimilation of the theme (van Peer & Maat, 2001). Furthermore, messages should be presented through different frames that can either emphasize the pleasures (gains) of adhering to the recommended behavior or the pains (costs) of not adhering (Kim & Lee, 2017). In general, the Prospect theory (Kahneman & Tversky, 2013) posits that people tend to be more likely to take risks when presented with a loss-framed message, and the contrary for a gain-framed message. However, although results on the effectiveness of message framing in cancer prevention and diagnosis often remained debated and controversial (Ainiwaer et al., 2021), in disease prevention, especially preventive behavior, a meta-analytic review proposed a persuasive (albeit small) advantage of a gain-framed message over a loss-framed message (Gallagher & Updegraff, 2012; O'Keefe & Jensen, 2016). In addition, intentions are considered a direct predictor of actions (Schwarzer & Luszczynska, 2008) and one of the standard measures of the effectiveness of health messages, along with attitudes and behaviors itself (Ainiwaer et al., 2021).

As previously elaborated in Chapter 2, the HAPA model serves as a robust theoretical framework that can effectively elucidate the factors and processes contributing to engagement in healthy preventive behaviors, including the decision to undergo BRCA1/2 genetic testing (Schwarzer, 2016). There is support for the use of this model for a better understanding of the initiation and maintenance of preventive behaviors, including cancer-related screening behavior (Daniel et al., 2014). As far as we know, no studies quantitatively and systematically tested the HAPA model in the context of men's adherence to CS for BRCA1/2 PVs.

Given these considerations, a better understanding of the decision-making process and accessible information about BRCA1/2 testing for at-risk men, as well as tailored materials to promote their adherence to CS are needed. Therefore, to fill this gap, the present research project aimed:

- to compare the effectiveness of two first-person gain-framed messages in promoting untested men's intention to adhere to CS for BRCA1/2 PVs; the messages emphasized the individual or family benefits of the adherence to CS, respectively;
- to identify men's characteristics (sociodemographic information, health status, psychological determinants from the HAPA model and literature) that may longitudinally explain and predict the intention to adhere to CS (and the planning of the action) among men facing BRCA-related cancer risk, as they were FDRs of BRCA1/2 female proband.

The following relationships were hypothesized:

- HP1: family-referred messages (FRM) could produce higher levels of intention to adhere to CS for BRCA1/2 when compared with a self-referred message (SRM), in men at high risk of BRCA1/2 variants;
- HP2: based on the HAPA model higher risk perceptions, outcome expectations and action self-efficacy (motivational factors) would longitudinally predict the intention to adhere to CS;
- HP3: higher intention and coping self-efficacy would predict higher planning;
- HP4: intention would serve as a mediator between motivational and volitional factors (planning).

Furthermore, a few research questions were formulated:

- RQ1: is there any difference between self- and family-referred positive outcome expectations in their association with the intention to adhere to CS?
- RQ2: what is the role of intolerance of uncertainty and health risk attitudes in CS adherence?

3.2 Materials and Methods

Recruitment and Procedure

This study was approved by the Institutional Review Board (IRB) of the European Institute of Oncology (IEO) (approval number R1249/20-IEO 1314). The IEO is a specialized hospital and internationally renowned cancer center situated in northern Italy, specifically in the city of Milan. IEO integrates the various areas related to the fight against cancer such as prevention, diagnosis, treatment, education, and research of cancer.

According to the registry of the Division of Cancer Prevention and Genetics (IEO), all female carriers with at least one documented germline pathogenic (C5) or likely pathogenic variant (C4) in either BRCA1 or BRCA2 genes who underwent genetic counseling and testing between 1998 and 2019, and with at least a male FDR were contacted by phone/email and informed about research purposes and procedure. The researcher asked the women to share the information with their male relative(s) and to invite him (them) to participate in the research study. Participation was voluntary and participants did not receive any financial, material, or other compensation for their participation in the study. After male relatives agreed to participate and completed informed consent, a questionnaire implemented on the Qualtrics^{TM} Platform was sent via link by email and was available for two weeks.

All data were collected in a pseudo-anonymized form, meaning that data were subjected to a de-identification procedure by which personally identifiable information fields in the data record were replaced by one or more artificial identifiers; specifically, the data collection process was done through an ID code (i.e., a combination of letters and numbers). Data were treated confidentially and used only by the researchers involved in the present study for scientific purposes. No harmful effects or benefits were expected due to the participation in the research. However, in case of necessity, the main researcher's personal contact was shared with the participants.

Table 1 shows the participants' inclusion and exclusion criteria.

Table 1: Inclusion and exclusion criteria for the male participants.

Inclusion criteria	*Exclusion criteria*
Male relatives of carriers with established pathogenic or likely pathogenic variants in BRCA1 and/or BRCA2 genes	Individuals tested for HCSs
Aged 18 years or older	Individuals with a prior diagnosis of cancer, including but not limited to breast, pancreatic, or prostate cancer.
Able and willing to provide informed consent.	

Proficient in reading, speaking, and understanding Italian.

The current study was designed as a longitudinal, double-blind, RCT, with participants randomly assigned to one of the two conditions where they received a self-referred narrative message (SRM) or a family-referred narrative message (FRM), to test the hypothesis and research questions (HP1). The flow chart presented in *Figure 3.* shows the progression of participants throughout the study, as envisaged in the initial research design protocol.

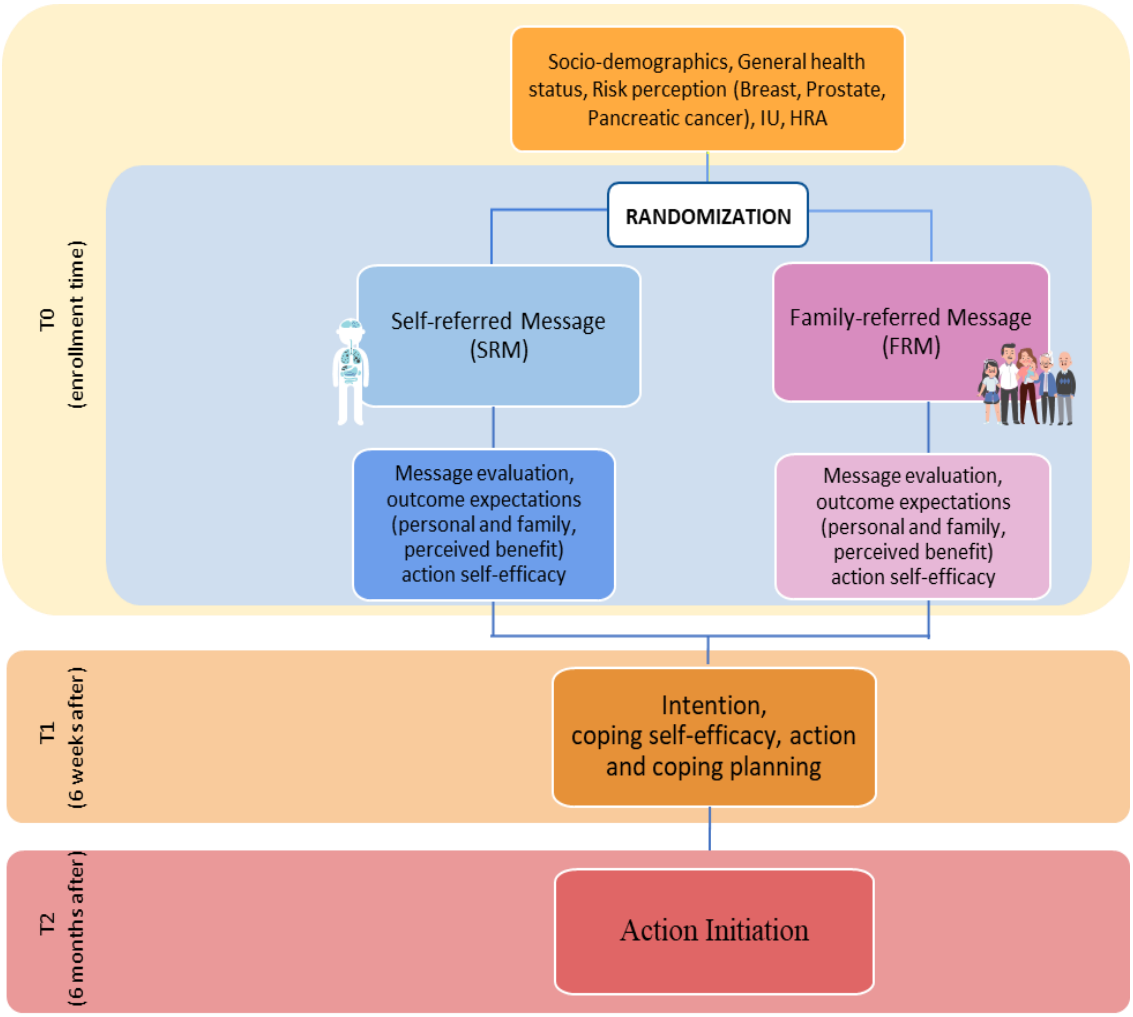

Figure 3. Flow chart of participants' progression in the proposed study.

However, as a result of revisions mandated by the IRB of the IEO, which aimed to avoid direct involvement in promoting participant adherence to CS, the originally planned

evaluation at the 6-month (T2) was removed. This evaluation was intended to assess the participants' actual engagement, specifically whether they underwent genetic testing for BRCA1/2.

Instead, it has been recommended to obtain information about participants' decisions regarding genetic testing by consulting the registry of tested individuals at the Division of Cancer Prevention and Genetics, IEO. This approach allowed us to gather data solely on those participants who chose to undergo genetic testing at the IEO. Nevertheless, within the framework of the HAPA model, it is acknowledged that the planning is regarded as the most immediate predictor of the actual action and a key determinant of successful outcomes. Consequently, our study underwent modifications, as depicted in *Figure 4*, illustrating the progression of participants through the two assessment points within the study (Time 0: T0, and Time 1:T1).

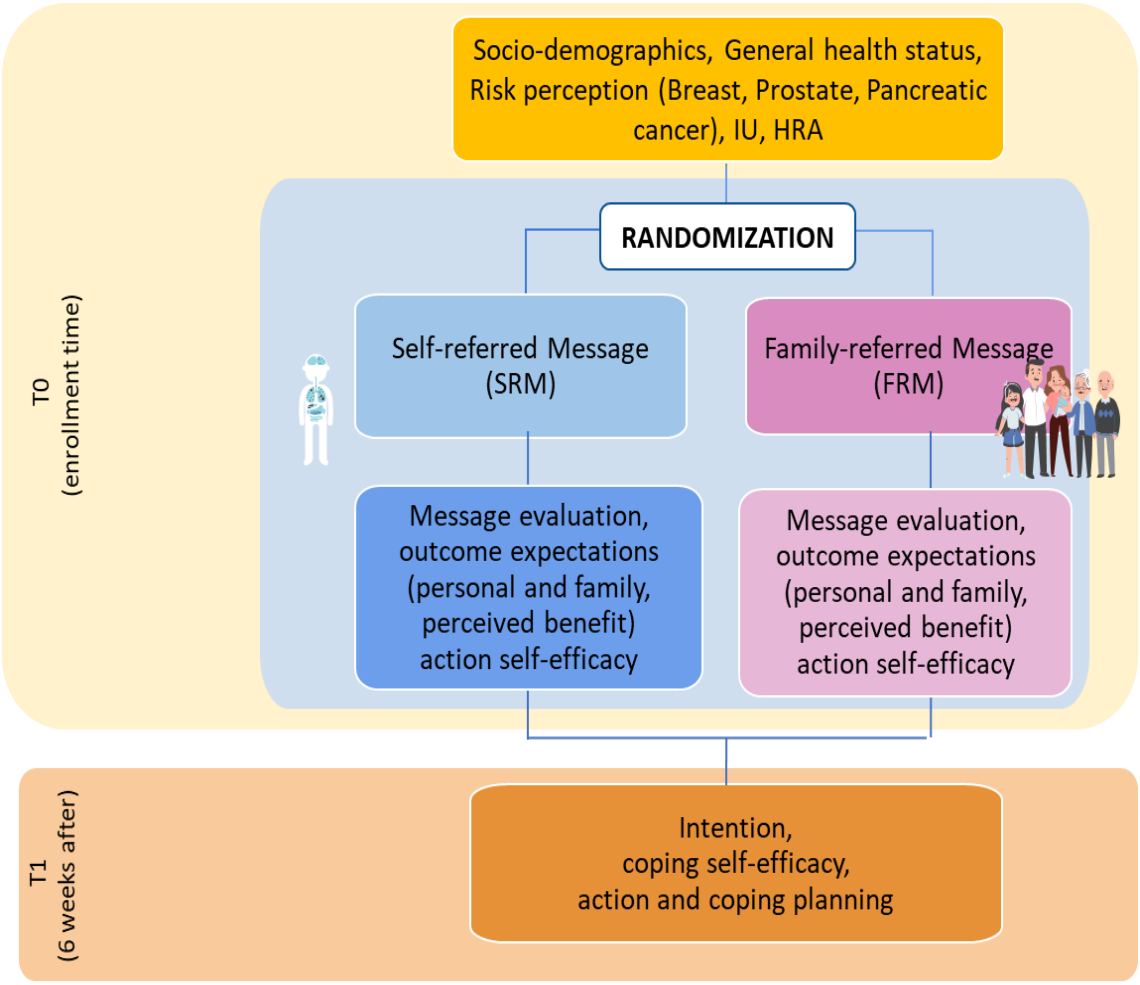

Figure 4. Flow chart of participants' progression in the final approved study.

Randomization occured during T0, immediately after the data collection of socio-demographic information and psychological measures. Participants as well as researchers who interacted with participants were not informed of the condition to which they had been assigned. However, researchers who analyzed the data collected were aware of the condition assigned to the participant. After the randomization and the message exposure, participants answered a manipulation check to ascertain if they had read and understood the message and replied to the other psychological measures. Since the HAPA model (Schwarzer & Luszczynska, 2008) does not state that there should be a waiting time between the measurement of the intention and the coping/action planning, the evaluation of these constructs was collapsed in one evaluation time. Specifically, six weeks after completing the first survey, a second link was shared via email evaluating their intention to undergo BRCA1/2 genetic testing (T1). Furthermore, a few weeks following the conclusion of their participation in the study, participants were sent a gratitude email, expressing appreciation for their involvement and providing them with the opportunity to contact the Division of Cancer Prevention and Genetics at the IEO should they wish to obtain further information regarding the test procedure, scheduling, or associated costs. To assess the feasibility and comprehensibility of our measures, a pilot study was designed. The recruitment phases lasted from September 2020 to August 2021, covering a duration of 48 weeks.

Measures

Ad-hoc and validated questionnaires were administered to collect information about different constructs.

T0

- *Socio-demographics*. Self-reported information about race/ethnicity, age, education level, occupation, civil status, parental status (0= without children; 1= with children), and degree of kinship with the carrier were collected.
- *Health Status*. Self-reported overall perceived health status and existing diagnosis for cancer or chronic disease were investigated with a single item each (Shim et al., 2006). Response options for overall perceived health status were on a 5-point Likert scale, from very poor to very good ("How would you rate your overall health compared to others of your same age?"). The response options for the item

on existing cancer or chronic disease were binary coded (no - yes, specify).

- *Risk perception.* The risk perceptions were evaluated through the use of three measures.
    - *Relative cancer risk perception* (RP), which encompasses the perception of one's likelihood to develop cancer (including breast, pancreatic, and prostate cancer), was assessed using single-item measures (Renner, 2003, 2004). Participants were presented with one questions for each type of cancer, and their responses were recorded on a 7-point Likert scale, ranging from 1 ("far below the average") to 7 ("far above the average"). For instance, a sample question is as follows: "Compared to people similar to you in age and gender, your chances of having prostate cancer in the future are:".
    - *Intolerance of Uncertainty (IU).* The Intolerance of Uncertainty Scale-12 (IUS-12: Bottesi et al., 2015) was applied to measure two dimensions of the intolerance of uncertainty, which were the desire for predictability (prospective factor) and uncertainty paralysis (inhibitory factor). The prospective factor can be considered an active management strategy for uncertainty and referred to the tendency to seek as much information as possible on situations perceived as threatening. The inhibitory factor represented an avoidance strategy towards ambiguous situations and referred to the inability to act due to uncertain feelings. Response options were on a 5-point Likert scale, from “completely disagree” to “completely agree”. In this study, Cronbach’s alpha coefficient was equal to .88 for the total scale (rs >.16; IUS Prospective: $\alpha = .825$; rs > .18; IUS Inhibitory: $\alpha = .84$; rs > .24).
    - *Health Risk Attitude* (HRA-6; Dieteren et al., 2020), a self-report scale that was validated in German and back-translated into Italian (Petrocchi et al., 2021). The 6-item self-report scale was administered to assess participants’ willingness to take risks in a health context and their risk management strategies. The response options for the assessment were on a 7-point Likert scale, spanning from "completely disagree" to "completely agree." A total score has been computed, with elevated scores signifying more pronounced risk-averse attitudes among the respondents. The scale showed good internal consistency ($\alpha = .79$, rs > .18).

- *Action Self-Efficacy (ASE).* Consistent with Schwarzer & Luszczynska's theory (Schwarzer & Luszczynska, 2008), self-efficacy was assessed through three items, as participants' capability to organize and execute the courses of the action. Response options were on a 5-point Likert scale, from 1 "completely disagree" to 5 "completely agree". A higher total score on the scale indicated higher levels of perceived self-efficacy. Additionally, the scale demonstrated good internal consistency ($\alpha = .83$; $rs > .59$).
- *Stimuli Messages.* Two different messages were proposed. In the gain-frame condition, the main character complied with the advocated behavior and achieves desirable outcomes (Gray & Harrington, 2011). Thus in the proposed message, the main character was a man, who speaks in the first person, and he highlighted the benefits and achievements of undergoing genetic testing to detect BRCA1/2 PVs. In the first condition, referred to as the Self-referred narrative Message (SRM), the primary character elucidated the personal reasons underlying the importance of the decision to undergo genetic testing (e.g., adopting preventive behaviors) and outlined the potential individual benefits associated with that decision. In the second condition, known as the Family-referred narrative Message (FRM), the narrative framework remained consistent with the SRM, but the character instead elaborated on the advantages of their decision for their family members. This message emphasized why the individual's choice to undergo BRCA1/2 genetic testing was significant for their family and directed attention toward addressing familial uncertainty conditions. The narrative perspective was not manipulated. The messages were designed to educate untested men from families with a BRCA1/2 PV about the personal relevance of such testing. It included an overview of the BRCA1/2 genes, inheritance and genetic testing procedure information, and the implications of BRCA1/2 testing for men and their children or other family members. The aim of the message was both affective and informative. On average, in our study, participants viewed this educational information for 84 seconds. See *Table 2* for details of the message text and *Appendix I* for the messages brochure, as shown to the participants.

Table 2. Message texts.

Self-referred narrative gain-framed Message (221 words)	***Family-referred narrative gain-framed Message (226 words)***
My name is Matthew and some time ago my sister was diagnosed with breast cancer. After a genetic test, she was found to be a **carrier** of a genetic mutation in a **BRCA gene**.	My name is Matthew and some time ago my sister was diagnosed with breast cancer. After a genetic test, she was found to be a **carrier** of a genetic mutation in a **BRCA gene**.
There are two BRCA genes: BRCA1 and BRCA2. The presence of a mutation in one of these genes is associated with a **higher risk** of developing **cancer** in some organs (breast, ovary, pancreas, and prostate) than in those without the mutation.	There are two BRCA genes: BRCA1 and BRCA2. The presence of a mutation in one of these genes is associated with a **higher risk** of developing **cancer** in some organs (breast, ovary, pancreas, and prostate) than in those without the mutation.
Both men and women can have BRCA1 or BRCA2 mutations. These mutations can be **passed on from parents to children.**	Both men and women can have BRCA1 or BRCA2 mutations. These mutations can be **passed on from parents to children.**
Having a mutation does not necessarily	Having a mutation does not necessarily

mean developing a tumor, but having a greater predisposition to develop it.	mean developing a tumor, but having a greater predisposition to develop it.
I decided to undergo a genetic test because I think it is **important to me.** They took my blood, got DNA from the sample, and detected the presence of the previously identified mutation in my family.	I decided to undergo a genetic test because I think **it is important to my family**. They took my blood, got DNA from the sample, and detected the presence of the previously identified mutation in my family.
What are the advantages of genetic testing? Whilst I discovered that I have a higher risk of developing certain forms of cancer in the future, the advantage of genetic testing and knowing that I have a mutated gene is that now I can **implement preventive behaviors** (more controls, lifestyle changes).	What are the advantages of genetic testing? Whilst I discovered that I have a higher risk of developing certain forms of cancer in the future, the advantage of genetic testing and knowing that I have a mutated gene is that now **my family can implement preventive behaviors** (more controls, lifestyle changes).
I think **my health** has benefited from the decision I made to undergo the test and from the identification of the mutation.	I think **the health of my family** has benefited from the decision I made to undergo the test and from the identification of the mutation.

- *Manipulation check.* A manipulation check was used to assess participants' comprehension of the message content. To do so, two custom-designed items were created for this purpose. These items were presented in a multiple-choice format, with one correct answer and two incorrect answers as distractors. Participants who failed to correctly answer these questions were excluded from the subsequent analyses to ensure that the results were based on participants who had adequately understood the message content.
- *Perceived Quality of the Message.* The Perceived Quality of the Message was

assessed using three items to gauge the message's credibility, persuasiveness, and overall quality. Participants provided their responses on a 7-point Likert scale, ranging from "completely disagree" to "completely agree," to indicate their level of agreement or disagreement with each statement. The scale revealed moderate internal consistency ($\alpha = 0.72$, rs > 0.24).

- *Outcome Expectations.* Outcome expectations were evaluated using three distinct measures or instruments. Each of these measures likely captured different aspects or dimensions of participants' expectations regarding the outcomes associated with their decisions about BRCA1/2 genetic testing.
    - *Self-referred positive outcome expectations* (SOE) were assessed using four ad-hoc items on a 5-point Likert scale, ranging from "unlikely" to "likely", evaluating the positive factors that individuals expect to achieve on a personal level if they engage in BRCA1/2 testing. For example, one item inquired "If I undergo a genetic test for BRCA1/2 I would be proud to take care of myself". A total score as the mean of the points assigned to each item was calculated, with higher scores indicating stronger self-referred positive outcome expectancies. The scale demonstrated good internal consistency ($\alpha = .73$, rs > .29).
    - *Family-referred positive outcome expectations* (FOE) were assessed using a set of four items on a 5-point Likert scale, ranging from "unlikely" to "likely" designed to evaluate the expected positive impacts on family members if an individual undergoes BRCA1/2 genetic testing. For instance, one item stated, "My family members will have important information for their health if I undergo a BRCA1/2 genetic test." To calculate a total score for this measure, the mean of the points assigned to each item was computed, with higher scores indicating stronger family-referred outcome expectancies. The scale demonstrated excellent internal consistency ($\alpha = .86$, rs >.54).
    - *Perceived Benefit* (PB): According to other studies (Petrocchi et al., 2020) a 5-digit semantic differential scale was used to present respondents with a set of bipolar adjectives (i.e., important/not important, relevant/irrelevant, valuable/useless, and so on) to evaluate the general perceived benefit of BRCA1/2 genetic testing. Respondents were asked to check the position on an unnumbered scale that indicated the extent to

which the adjectives relate to their perceived benefit. The scale consisted of 10 bipolar adjectives, and higher scores on this scale indicated a greater perception of benefit. The scale demonstrated good internal consistency for the overall score (α = .89, rs > .19).

T1

- *Intention.* The intention to adhere to CS was assessed using three items, which gauged the individual's inclination or desire to engage in this behavior. An example item is: "In the next few months, do you have the intention to uptake genetic testing?". Participants expressed their intention on a 5-point Likert scale, ranging from "very improbable" to "very probable." To derive an overall score for this measure, the mean of the scores assigned to each item was computed. Higher scores on this scale indicated a stronger intention to adhere to CS. The scale demonstrated moderate internal consistency in the present study (α = 0.69, rs > 0.32).
- *Planning.* Ad-hoc items were used to assess participants' planning regarding when, how, and where to undergo BRCA1/2 genetic testing (*Action planning* - 3 items). Additionally, participants were asked whether they had developed plans to address challenges that might arise during this planning process *(Coping planning* - 4 items), following Schwarzer and Luszczynska's model (2008). For the Action planning items, participants used a 5-point Likert scale, ranging from "not true at all" to "very true." An example item is: "I made plans about when to do genetic testing (e.g., taking work permits)". For the Coping planning items, participants used a 5-point Likert scale that ranged from "very improbable" to "very probable". To obtain an overall score, the mean of the scores assigned to the respective items was calculated. Higher scores indicated a higher degree of planning. Importantly, the scale demonstrated good internal consistency (α = .61; rs >.16).
- *Coping Self-efficacy (CSE).* Following Schwarzer's theory (Schwarzer & Luszczynska, 2008), a set of three ad-hoc items on a 5-point Likert scale, ranging from "not at all" to "completely", were created to assess individuals' perceived ability to cope with potential obstacles that might hinder their ability to undergo genetic screening. An example item is: "How do you feel you’re capable of tackling the obstacles and difficulties that could make it difficult for you to

undergo genetic screening?". An overall score has been calculated as the mean of the scores assigned to each item. Higher scores on this scale indicated a stronger sense of coping self-efficacy. In the present study, the scale displayed moderate internal consistency ($\alpha = .76$, rs >.38).

Sample size

The sample size for the study was determined through a priori power analysis using GPower 4.0 (Faul et al., 2007). Several parameters were considered for this analysis, including a conservative squared multiple correlation of 0.15 between each predictor and the outcome (as per Luszczynska et al., 2011), an alpha level lower than 0.05, and a desired power (1- B) of 0.95. The study involved two groups, corresponding to the two experimental conditions. Based on these considerations, the final estimated number of participants was determined to be 103.

Data Analysis

Data analyses were performed using the statistical software analysis package SPSS (Version 28.0). Normality and presence of missing data were checked; data resulted normally distributed. Missing data were less than 5%, handled with Complete Case Analysis (CCA). Manipulation check's answers were analyzed before the main analyses, to check participants' reading of the message and their comprehension. Participants who failed to answer those questions were excluded from the analyses.

To explore the socio-demographic characteristics of the final sample descriptive analyses were performed. Pearson's r or Spearman's Rho correlations were performed to assess the relationships between variables in the study. Independent samples t-tests and contingency tables with chi-square tests were employed to identify systematic differences in the distribution of socio-demographic information between the two groups. Analysis of Covariance (ANCOVA) was used to determine the effect of group assignment (SRM vs. FRM) on intention levels while controlling for sociodemographic characteristics. Differences in intention levels related to parental status were explored using an independent samples t-test. A hierarchical multiple regression analysis was performed to identify predictors of intention and assess the predictive power of intention on planning. A simple mediation analysis was conducted using the PROCESS 3.4 macro for SPSS to investigate the impact of significant predictors on planning, mediated by intention constructs. Planning, perceived benefit, and intention were included in the analysis as

dependent, independent, and mediator variables respectively. Age, parental status, and CSE were considered covariate variables. Risk perception data were extensively investigated through one-way ANOVA and Bonferroni correction.

3.3 Results

Participants

A total of 206 female BRCA1/2 PV carriers were contacted. Of these, 94 carriers agreed to participate in the study and actively involved their male FDRs. The remaining either declined participation in the study, had no male FDRs, had no eligible male FDRs (oncological diagnosis, already tested, etc.), or agreed to share information with male FDRs but their FDRs did not agree to participate in the study.

The final sample of this longitudinal study comprised a total of 110 male FDRs of female BRCA1/2 carriers that were included in the analysis, 55 participants for each group (SRM and FRM groups). 99 participants out of 110 completed the T1 follow-up survey. Participants' age ranged between 18 and 81 (M_{age}= 41.36; SD= 17.21). The majority of the participants were employed and well-educated, and approximately half of the participants had offspring, ranging from 1 to 6 children (M= 1.9; SD= .99). Regarding their self-reported health status, most of the participants enjoy good/very good health conditions (63.6%), and only a small percentage of the participants had suffered from chronic disease (such as diabetes or hypertension; 30%). The majority of the participants were brothers or sons of the affected carriers. Regarding female BRCA1/2 carriers, all have been affected by cancer, predominantly breast cancer (83%; N=78) or ovarian cancer (7.5%; N=7), or by both ovarian and breast cancer (9.5%; N=9). No one of the participants were removed from the sample due to failing the manipulation check. More descriptive statistics are presented in *Table 3*.

Table 3. Socio-demographic data

		Self-Referred Narrative Message group (N=55)		*Family-Referred Narrative Message group (N=55)*		*Total sample (N=110)*	
Variables		Frequency	%	Frequency	%	Frequency	%
Occupation	Employed	41	74.5	44	80	85	77.3
	Not employed	14	25.5	11	20	25	22.7
Education	Primary/Secondary School	14	25.5	6	10.9	20	18.2
	High School	20	36.4	33	60	53	48.2
	University	21	38.2	16	29.1	37	33.6
Parental Status	With children	30	45.5	21	38.2	51	46.4
	Without children	25	54.5	34	61.8	59	53.6

Degree of Kinship with the proband	Brothers	24	43.6	23	41.8	47	42.7
	Sons	19	34.5	28	50.9	47	42.7
	Fathers	8	14.5	-	-	8	7.3
	More than one	4	7.3	4	7.3	8	7.3

Messages exposure and effects on intention to adhere to CS

Firstly, analyses were conducted to test the first hypothesis (HP1), consistent with the impact of the two tailored messages on the intention to adhere to CS. T-tests showed no difference between the two groups regarding the mean scores in the perceived quality of the message ($t_{(108)} = -.807$, $p > .05$); specifically, both groups perceived the message as averagely credible, convincing, and persuasive (*SRM:* M= 5.26; SD =.92; *FRM:* M = 5.40; SD= .88).

Despite randomization in the two groups, t-tests showed a significant difference between SRM and FRM groups regarding age levels ($t_{(108)} = 2.811$, $p = .006$), with the SRM group being older (M_{age}= 45.84; SD= 18.56) than the FRM one (M_{age}= 36.89; SD= 14.58). Based on the ANCOVA results, the covariate age was significantly related to the participant's intention to adhere to CS, $F_{(1, 96)} = 4.82$, p=.031. However, there was not a significant effect of the group assigned on levels of intention, after controlling for the effect of the age, $F_{(1, 96)} = 1.01$, $p > .05$. Specifically, participants' levels of intention did not differ depending on the group to which they were assigned, that is, depending on the message they received (*SRM:* M=3.21; SD=.93; *FRM:* M=3.41; SD=.81). Furthermore, t-tests showed no differences between the SRM and FRM groups regarding the mean scores in SOE ($t_{(108)} = -.728$, $p > .05$) and the scores in FOE ($t_{(108)} = .628$, $p > .05$).

Because of the null result for the primary hypothesis (HP1), data collected from the two groups were combined, and further analyses were undertaken to determine which psychological variables were associated with or predicted the intention to adhere to CS and the planning of the action.

Preliminary analysis

Considering the intention to adhere to CS as the primary outcome, results showed

significant associations between intention to adhere to CS and age, parental status, breast cancer RP, SOE, PB, and CSE. Furthermore, considering the planning of the action as the secondary outcome, results showed significant associations between planning and the intention, as well as CSE. *Table 4* provides a summary of key statistics and correlations between the main variables under investigation.

Significantly, our analysis revealed a robust negative correlation between the participants' intention to adhere to CS and their age. This finding substantiates that advancing age is consistently associated with reduced levels of intention to pursue CS Younger participants showed higher levels of intention to adhere to CS. Furthermore, results unveiled a noteworthy negative correlation between intention and parental status. A t-test analysis demonstrated a significant disparity in intention to adhere to CS between participants with children and those without ($t_{(91)}= 2.34$, $p= .011$). Specifically, males without children exhibited notably higher intention levels (M= 3.51; SD =.84) in comparison to their counterparts who were fathers (M = 3.08; SD =.84).

A significant positive correlation between intention and breast cancer RP, SOE, PB, and CSE was found. These findings suggested that individuals who exhibited higher levels of intention in the context of CS tended to possess a heightened sense of risk perception for breast cancer, more positive self-referred outcome expectations, greater recognition of the benefits linked to genetic testing, and increased confidence in their ability to cope with challenges.

Contrary to the expectations, no significant correlation was found between intention to adhere to CS and FOE, ASE, IU and HRA. Additionally, it is noteworthy to observe that within the spectrum of RP, a singular association emerged as statistically significant concerning the intention to adhere to CS — specifically, the perceived risk for breast cancer. This finding elucidated that individuals who perceived a greater risk of developing breast cancer were more inclined to express stronger intentions to engage in CS as a preventive measure. Finally, in alignment with the expectations derived from the HAPA model, a significant positive correlation between planning and intention and CSE was found.

Table 4. Means, standard deviations, and correlation coefficients for the main variables examined in the study.

	M (SD)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. AGE	41.36 (17.21)	.71**	-.24**	.18	-.09	.13	.01	.25**	.16	.07	.10	.10	.05	-.20*	.02	-.10
2. PARENT^	-	-	-.22*	.11	-.02	.03	.07	.26**	.10	.03	.05	.05	.01	-.23*	-.01	-.08
3. BrRP	3.11 (1.59)		-	.38**	.51**	.01	-.07	-.09	.02	-.14	-.10	-.13	.06	.23*	.15	.12
4. PrRP	3.86 (1.13)			-	.59**	-.03	.10	.12	.06	.03	.09	.05	-.12	-.05	.01	-.01
5. PaRP	3.5 (1.22)				-	-.07	.10	.01	.10	-.04	-.06	-.05	-.07	.06	-.00	.19
6. ASE	4.61 (0.67)					-	.04	.14	.14	.31**	.18*	.28**	-.01	-.11	.04	.03
7. SOE	4.1 (0.71)						-	.62**	.50**	.01	.08	.05	.11	.19*	.12	.13
8. FOE	4.17 (0.83)							-	.37**	.12	.22*	.18	.09	.01	.03	.01
9. PB	4.05 (0.83)								-	.05	.02	.05	.18	.32**	.21*	.29**
10. IU_P	22.6 (5.25)									-	.65**	.93**	-.17	-.11	-.07	-.06
11. IU_I	11.62 (4.02)										-	.86**	-.27**	-.13	-.11	-.24*
12. IU	34.23 (8.34)											-	-.23*	-.12	-.08	-.16
13. HRA	5.18 (0.93)												-	.01	.19	.26*
14. INT	3.31 (0.86)													-	.34**	.23*
15. PLAN	3.05 (0.55)														-	.38**
16. CSE	3.54 (0.73)															-

Legend: Parental Status (Parent); Breast Cancer Risk Perception (BrRP); Prostate Cancer Risk Perception (PrRP); Pancreatic Cancer Risk Perception (PaRP); Action Self-Efficacy (ASE); Self-referred Outcome Expectations (SOE); Family-referred Outcome Expectations (FOE); Perceived Benefit (PB); Prospective Intolerance of Uncertainty (IU_P); Inhibitory Intolerance of Uncertainty (IU_I); Intolerance of Uncertainty (IU); Health Risk Attitude (HRA); Intention (INT); Planning (PLAN); Coping Self- Efficacy (CSE).

*Note: * $p < .05$; ** $p < .01$.* Correlation coefficients are Pearson's *r* except for ^ Spearman's Rho.

Psychological predictors of intention and planning levels

According to the HAPA model, and to better understand which psychological variables could longitudinally predict a) the intention to adhere to CS and b) the planning of the action, two simple linear regressions were carried out. Variables that were found to be significantly associated with intention to adhere to CS and with planning were included in the analyses, and considered as possible predictors. The analyses were controlled for socio-demographic variables.

In the context of longitudinal predictors of intention (HP2), our analysis yielded a noteworthy finding: among the examined variables, only the perceived benefit associated with genetic testing emerged as a significant predictor of the intention to adhere to CS ($\beta = .30$, SE = .12, t = 2.71, $p < .01$). This indicated that individuals who perceived greater benefits linked to genetic testing were more likely to express stronger intentions to adhere to CS over time. The overall model demonstrated statistical significance, explaining approximately 28.4% of the variance in the intention to adhere to CS ($F_{(6,93)} = 5.35$, $p < .001$). It is noteworthy that the other variables examined in the model (age, parental status, breast cancer RP, SOE, and CSE) were not retained as significant predictors in this longitudinal analysis.

Additionally, by our hypothesis (HP3) and following the framework of the HAPA model, a linear regression analysis was conducted to assess the significant predictors of planning. This analysis was conducted while controlling for sociodemographic variables and other psychologically significant variables. The results showed intention and CSE as significant predictors of the planning of the uptake of genetic testing (Intention: $\beta = .26$, S.E = 0.75, t = 2.22, $p < .05$; CSE: $\beta = .31$, S.E = 0.79, t = 2.91, $p < .01$). The model resulted significant, and explained 21% of the variance ($F_{(7,92)} = 3.03$, $p < .01$).

Even when considering entering sociodemographic variables (age and parental status) in a separate last step due to the strong correlation between these variables, with the aim of understanding how each variable contributes to explaining the variation in the final outcome, the previously presented results did not changed.

Regression coefficients are shown in *Table 5*.

Table 5. Regression Tables

	Dependent variables			
	Intention to adhere to CS		Planning the action	
	β	***P***	**β**	***P***
Step 1: Sociodemographic				
AGE	-.231	.102	-.009	.949
PARENT	-.102	.468	-.041	.789
$F_{(2,97)}$= 4.51*; R^2= 9.6%			$F_{(2,97)}$= .09; R^2= 0.2%	
Step 2: Psychological variables				
AGE	-.243	.071	.022	.881
PARENT	-.088	.500	-.025	.860
BrRP	.127	.205	.103	.342
SOE	.116	.297	.059	.620
PB	.305	.008**	.094	.446
CSE	.126	.198	.334	.002**
$F_{(6,93)}$= 5.35***; R^2 =28.4 %			$F_{(6,93)}$= 2.58*; R^2= 16.1%	
Step 3 Intention				
AGE	-	-	.085	.555
PARENT	-	-	-.002	.989
BrRP	-	-	.070	.513
SOE	-	-	.029	.804
PB	-	-	.014	.911
CSE	-	-	.301	.005**
INT	-	-	.261	.029*
			$F_{(7,92)}$=3.03**; R^2= 21%	

Legend: Parental Status (Parent); Breast Cancer Risk Perception (BrRP); Self-referred Outcome Expectations (SOE); Perceived Benefit (PB); Intention (INT); Planning (PLAN); Coping Self-Efficacy (CSE). *Note:* * p < .05; ** p < .01; *** p < .001

Mediation results

Mediation analysis was performed to assess the mediating role of intention in the relationship between perceived benefit and planning of the action. So perceived benefit was included as the independent variable. Sociodemographic variables (age and parental status) and CSE were included as covariates in the final model. The study's findings indicated a noteworthy indirect effect of perceived benefit on planning, as illustrated in *Table 6*. Perceived benefits had a positive impact on intention (β = .36, SE = .11; p < .001; 95%CI [.184, .611]), and in turn, intention positively influenced action planning (β = .27, SE = .07; p < .01; 95% CI[.029, .319]). However, it is important to note that the direct effect was not supported, meaning that perceived benefit did not have a direct predictive effect on action planning (p = .83). Among the covariates, results revealed a significant effect of age in the prediction of the intention levels (β = .01, SE = .05; 95% CI [.029, .002]. Finally, intention resulted as a positive total mediator of the relationship between perceived benefit and planning. The final model explained 21% of the variance. Hence, HP4 was supported. *Figure 5*. shows the mediation model, with significant path coefficients.

Table 6. Mediation analyses

Independent variable: Perceived Benefit *Mediator*: Intention *Covariates*: Age, Parental Status, CSE			
	Direct effect	Indirect effect	Total effect
Planning	β = .02 SE = .07 [95%CI]=-.137, .169	β = .10 SE =.06 [95%CI]=.009, .229	β = .12 SE =.07 [95%CI]=-.061, .231

Legend: Standard Error (SE); Confidence Intervals (CI);

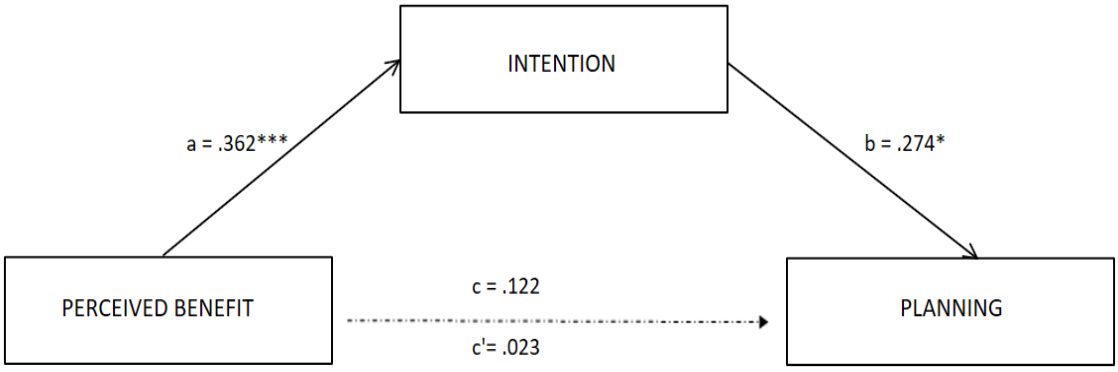

Figure 5. Results of the Mediation Model

Note: * p < .05; ** p < .01; *** p <.001. Significant path coefficients were displayed by continuous lines; non significant paths were displayed by dotted lines. The covariates were only estimated in the model.

Cancer Risk Perception

Additional investigations were conducted around the risk perception construct, specifically around breast cancer risk perception considering that resulted as the only RP with a significant association with the intention to adhere to CS, although no causal relationship has been found (see regression's results).

As demonstrated by the correlation results (see *Table 3*), age showed a negative correlation with breast cancer risk perception (r= -.24, *p*< .01), and specifically younger participants showed higher levels of breast cancer risk perception. Also parenting status showed a negative correlation with breast cancer risk perception (r= -.22, *p*< .05). The t-test provided further confirmation of this result, demonstrating a significant difference between participants with children and those without children in terms of their breast cancer RP ($t_{(108)} = 2.14$, $p = .017$). Males without children showed higher breast cancer RP (M= 3.41; SD =1.59) compared to males with children (M = 2.76; SD =1.53). One-way ANOVA analysis found a significant effect of degree of kinship on participants' perceived risk of breast cancer ($F_{(3,107)}= 3.68$, $p< .01$). In particular, it can be seen, following the application of post-hoc analysis using Bonferroni- corrected pairwise comparisons method, that subjects with more than one family member carrying BRCA1/2 PV manifested significantly higher perceptions of breast cancer risk (M= 4.38, SD=.51) than siblings of BRCA1/2 mutation carriers (M= 2.68; SD= 1.62). Results revealed no

statistically significant difference in the other degree of kinship (sons of the carrier: M= 3.33; SD=1.56; fathers of the carrier: M=2.57; SD=1.41).

Furthermore, as shown in *Table 4*, the overall average of RPs was generally low (3 out of 7). Specifically, the relative RP of breast cancer was the lowest; surprisingly, participants perceived themselves to be below average when comparing their risk of breast cancer with people of their same sex and age, showing an optimistic bias (3.11 out of 7). Perceptions of risk for prostate cancer and pancreatic cancer were also below average, respectively 3.86 e 3.5 out of 7.

Other findings and genetic testing uptake

Other interesting findings resulted in the constructs of familial outcome expectations. Indeed, FOE showed a significant positive correlation with both age and parental status, meaning that older and with children participants showed higher expected benefits at the familial level. To be more specific, the t-test revealed a significant difference between participants with children and those without children in terms of their familial outcome expectations ($t_{(108)} = -2.64$, $p = .005$). Males with children showed higher familial outcome expectations (M= 4.39; SD =.71) compared to males without children (M = 3.98; SD =.88). No significant and interesting results were found around the two additional constructs of HRA and IU, not involved in the HAPA model (RQ2). Furthermore, through the consultation of the registry of tested men at the Division of Cancer Prevention and Genetics, IEO, information on participants' adherence to CS was retrieved. Specifically, at 6 months after initial enrollment, there were 11 participants (10%) who contacted the Division of Cancer Prevention and Genetics (IEO), to schedule genetic counseling for BRCA1/2 genetic testing. Information on the remaining participants who may not have contacted the Division was not available, as explained in the "*Recruitment and procedures*" section.

3.4 Discussion

This work was partially adapted from the article "Psychological Determinants of Men's Adherence to Cascade Screening for BRCA1/2" published in Current Oncology and written by Giulia Ongaro, Serena Petrocchi, Mariarosaria Calvello, Bernardo Bonanni, Irene Feroce, and Gabriella Pravettoni (2022). The present research focuses on the evaluation of the psychological determinants of men's adherence to CS for BRCA1/2

PV and aims to identify the motivational drives that might support men's informed decision-making about genetic testing. This study begins with an urgent need to understand how male FDRs of female BRCA1/2 carriers were motivated to protect themselves and others (Pritchard et al., 2019).

Tailored messages effectiveness in promoting men's adherence to CS

Some qualitative studies focusing on the experience of men within positive BRCA1/2 families showed that men and women may be driven by differential motivations in their decision to undergo genetic screening (P. Daly et al., 2003; Lodder et al., 2001; Peshkin et al., 2021; Shiloh et al., 2013; Strømsvik et al., 2010). These studies supported the idea that men tended to perceive the decision to adhere to CS as a "family duty", undergoing BRCA1/2 genetic testing for the sake of one's family members, and specifically one's sons and daughters. However, contrary to expectations, our results suggested no differences in terms of promoting intention to adhere to CS between messages focused on individual benefits and messages focused on family benefits, that is, there is no difference between family- and individual-drives on men's intention to adhere to CS for BRCA1/2 PV. The two tailored messages were unable to produce differences in the levels of intention to adhere to CS in this understudied population.

There were several plausible explanations for this outcome. As indicated and informed by prior qualitative studies, our initial expectation was that a family-oriented approach could prove more efficacious in motivating men to adhere to CS in contrast to an individual-centered approach (HP1). However previous studies investigated men's motivation to uptake BRCA1/2 genetic testing in tested men predominantly. Therefore, the framing was consequent to BRCA1/2 genetic testing and genetic counseling sessions. Genetic counselors play a crucial role in facilitating informed decision-making by providing essential information, resources, various genetic testing options, and offering support in addressing the complexities of a family history of cancer. Moreover, genetic counseling aims to enhance subjects' comprehension and adjustment to the implications of their test results, taking into account the familial implications of the GRI. Consequently, if genetic counseling assists individuals in grasping the familial consequences and advantages of GRI, it is conceivable that previous research approaches may not have effectively addressed motivation for testing if it was investigated as a result of genetic counseling consultation. Our hypothesis posits that untested men who had not

undergone prior genetic counseling may have had limited awareness regarding the familial implications of genetic information. This potential lack of awareness may elucidate the limited effectiveness of our tailored FRM, which primarily focused on family-driven motivations.

Other factors may explain the results associated with the two tailored messages. Specifically, the use only of the gain frame in the tailored messages could explain their ineffectiveness in producing different levels of intention to adhere to CS. When subjects are exposed to first-person narratives, framing effects could depend on the subjects' current stages of change (Kim & Lee, 2017). In this study, we did not have precise information about the stage of change of the participants; however, considering that these were subjects who had never undergone genetic counseling and had never been in contact with the Division of Cancer Prevention and Genetics (IEO), it is possible to infer that they were not yet moving toward enacting the behavior. Possibly they could be in a pre-contemplative or contemplative stage of change, that is a pre-intentional phase. For current smokers in the pre-contemplation stage, a loss-framed first-person narrative induced greater quit intentions and stage progression when compared with a gain-framed (Kim & Lee, 2017). However, the number of subjects recruited and the difficulty in involving them in the study would not have made it possible to test another tailored message with a loss frame as well. Future studies should expand the sample analyzed and investigate this further, comparing the effectiveness of two different framings according to participants' stage of change in men at high risk for BRCA1/2 PVs.

Furthermore, the effect of the messages in promoting the intention to adhere to CS was tested longitudinally, and specifically after 6 weeks. Message retention is essential to sustain the effect of the message itself (Suka et al., 2020). However, in this study message retention at 6 weeks was not checked. Literature supported message repetition as a valuable strategy to increase the likelihood of message retention and to influence participants' responses to tailored messages (Cacioppo & Petty, 1979; Shi & Smith, 2016). To improve the sustainability of the message that encourages seeking BRCA1/2 genetic testing, it might be useful to test if repeated messages about BRCA1/2 PVs implications would be able to increase intention to adhere to CS. Furthermore, it is important to take into account that men's engagement with HBOC syndrome has received relatively less attention in awareness campaigns. This discrepancy in awareness efforts could have had an impact on the efficacy of the communicated messages. Achieving awareness is a crucial step in informing men about their responsibilities in safeguarding

not only their own health but also the well-being of their loved, serving as a catalyst for making them cognizant of the associated risks (Peshkin et al., 2021).

Psychological determinants of men's adherence to CS

According to the HAPA model, the role of RPs, outcome expectancies, and CSE in predicting the intention to adhere to CS for BRCA1/2 PVs were only partially supported. The results of this study showed that men's intention to adhere to CS can be longitudinally predicted only by the general perceived benefit associated with genetic testing (HP2). Interestingly in a pre-intentional phase, rather than expectancies related to the self or the family, the key factor that could longitudinally predict the intention to adhere to CS was the general expectation of outcome and the perceived benefit from undergoing BRCA1/2 genetic testing. In this context, our results showed that action self-efficacy was neither associated with nor predicted intention to adhere to CS. The act of undergoing genetic testing is a one-time event, referred to as a "one-shot behavior," which does not necessitate the need for ongoing maintenance. Consequently, the relevance of the ASE framework in the context of genetic screening for BRCA1/PVs may not be as pronounced as it is for other preventive behaviors, such as physical activity, where behavior maintenance plays a pivotal role, and the role of ASE has been observed to be relevant (C. Q. Zhang et al., 2019). Furthermore, the act of undergoing genetic testing often stems from a medical recommendation, and it does not necessitate the subject to possess specific skills or abilities to perform the action, especially considering that the actual procedure is administered by healthcare professionals. Instead, what appears to be more pertinent in the context of this specific behavior is the individual's perception of self-efficacy in dealing with potential obstacles that may arise both before and after the behavior is enacted. This concept, known as CSE, demonstrated greater relevance and has been observed to be correlated with the intention to undergo genetic testing and the formulation of action plans.

Our findings, according to Schwarzer and Luszczynska (2008), showed that RP by itself was insufficient to generate and predict an intention, but it can be considered necessary to set the subject in a contemplation phase, in which untested men were made aware of the existence of a problem.

Consistent with HP3 and the HAPA model, our results highlighted the role of the intention and coping self-efficacy in predicting the planning of the action. Furthermore,

a relationship between perceived benefit and planning the action through the mediation of the intention was shown. In particular, the greater the perceived benefits of undergoing BRCA1/2 genetic testing, the greater the intention and therefore the likelihood of planning to be tested, and adhering to CS (HP4). Therefore, it might be proposed that increasing men's awareness regarding the benefit of BRCA1/2 genetic testing, paired with their role in HBOC syndrome, and their vulnerability to possible BRCA1/2 PVs, would consequently enhance preventive behaviors. The principles of the HAPA model have proven to be partly valid when applied to this context.

Taking into account the relationship between intention and various factors, results showed that beliefs that BRCA1/2 genetic testing has more positive consequences and outcomes for one's personal life were longitudinally associated with higher intention to adhere to CS (RQ1). However, it is important to note that this belief was not found to be a predictive factor, meaning that while it was associated with higher intention, it did not directly influence or predict the intention to adhere to CS. Surprisingly, no significant association was detected between family-referred outcome expectancies and intention to adhere to CS (RQ1). Although, as expected, participants with children perceived a higher level of familial benefit (familial outcome expectations) than those without children, this was not found to predict the intention to adhere to CS. These results are in contrast to a previous qualitative study that supported the notion that men's decision about CS is linked to the desire to protect their family members rather than to ascertain the risks to themselves (P. Daly et al., 2003; Lodder et al., 2001; Shiloh et al., 2013; Strømsvik et al., 2010). As argued above, such explanations tend to overlook the fact that these results have been descriptive in nature, and have only been carried out in already tested men, who retrospectively report their motivation to undergo genetic testing.

To further substantiate our results, it is noteworthy that males without children exhibited significantly higher levels of intention compared to males who were fathers. This outcome contradicted the initial expectations and suggested that, in the pre-intentional phase, the presence of offspring and the potential familial benefits might not be the primary motivational factors influencing the intention to adhere to CS. Instead, it underscored the significance of the general perception of the benefits associated with CS as a key motivator. It is advisable for future studies to further validate these results by conducting comparative analyses between men who have already undergone testing and those who have not yet undergone testing. This approach could provide additional insights into how individuals' experiences influence their intentions and behaviors in the

CS context, shedding more light on the complex dynamics at play in the decision-making process regarding genetic testing for BRCA1/2 mutations.

Furthermore, it is worth noting that younger males in our study exhibited higher levels of intention to adhere to CS compared to their older counterparts. This indicates that being of a younger age acted as a facilitating factor for the intention to undergo genetic testing. This observation aligns with prior research in the literature, which has consistently linked younger age to greater interest and more positive attitudes toward genetic testing (Cherkas et al., 2010; Henneman et al., 2012; Oliveri et al., 2021; Ongaro, Brivio, et al., 2022). Furthermore in our study, the youngest participants were generally sons of the BRCA1/2 carriers; and this may have led them to experience their mother's illness more closely, impacting their intention to protect themselves through preventative behaviors. These findings underscored the importance of considering age as a significant factor in the decision-making process related to genetic testing for BRCA1/2 mutations. It suggested that younger individuals may be more receptive to and motivated toward genetic testing, which has implications for tailoring interventions and communication strategies to different age groups within the target population.

Cancer risk perceptions in untested men

As already reported, males with higher breast cancer risk perception were also the most intentioned to adhere to CS for BRCA1/2. Surprisingly, this relationship was not significant for other risk perceptions, as if the awareness of being at high risk for breast cancer for a man was emotionally activating, impacting the intention to adhere to preventive screening behaviors. This might be considered a result of the gendered construction of breast cancer as a women's illness (McAllister et al., 1998; Quincey et al., 2016). The increased prevalence, awareness raising, research, the creation of associations, and the "pink ribbon" as an international symbol of breast cancer awareness in women have reinforced the perception that breast cancer is a women-only problem, even though breast cancer in men is responsible for proportionately higher rates of mortality than either testicular and penile cancers (Quincey et al., 2016).

Literature suggested that the idea of living with a feminized illness could be very distressing and stigmatizing for some men, resulting in a profound change to body image and sexuality, and impacting how men perceived their bodies and identities (Donovan & Flynn, 2007; Skop et al., 2018). The data reported here appeared to support the

assumption that when men's self-perceptions of their masculinities were impacted by the awareness of higher breast cancer risk, this affected the preventive behaviors that men were intentional about enacting. Furthermore, a significant family history of multiple breast cancer could produce in men concerns about developing breast cancer themselves (Liede et al., 2000; McAllister et al., 1998). Indeed, in our study, data concerning cancer localization of the BRCA1/2 carriers showed that the majority of them were affected by breast cancer. It should also be noted that participants had not yet undergone genetic counseling, where one of the aims is to help people understand their augmented risk for cancer. Consequently, they may present inaccurate knowledge about their risk and may not be well informed about the higher risk in male carriers for prostate or pancreatic cancer risk. Furthermore, some studies reported that not affected by cancer men, tested for BRCA1/2, perceived higher cancer risk irrespective of the genetic test result (Liede et al., 2000).

It is worth noting that our study yielded an interesting observation: the general cancer risk perception among men in BRCA1/2 positive families was notably low. Surprisingly, these individuals perceived themselves as being at lower risk than the average population of the same age and gender. This finding aligned with similar studies conducted on FDRs and SDRs of carriers with HCSs (Bjorvatn et al., 2007; Rantala et al., 2009), where relatives tended to perceive their cancer risk as lower when compared to their peers of the same age and gender. This pattern of risk perception suggested that individuals with a familial predisposition to HCSs might tend to underestimate their risk. People used to apply cognitive regulation strategies to reduce the distress that the awareness of being at high risk would cause them; consequently, they perceived themselves to be less at risk of cancer than the rest of the population (Shiloh et al., 2009). Risk perception resulted in potential emotion regulation strategies used by high-risk individuals. This underscored the importance of effective risk communication and education, particularly for those at increased genetic risk, to ensure a more accurate understanding of their cancer susceptibility. An intriguing avenue for future research could involve exploring the impact of this underestimation of cancer risk perception on compliance with cancer surveillance programs. This research could delve into the connection between individuals' perceptions of their cancer risk and their adherence to recommended cancer screening protocols within this high-risk population. It would shed light on the factors that motivate or hinder high-risk individuals from participating in essential screening and surveillance, ultimately contributing to improved preventive

healthcare in this population.

Moreover, younger men showed higher levels of breast cancer risk perception. As mentioned above, young men were generally sons of the BRCA1/2 carriers. As supported by Liede et al. (2000), BRCA1/2 tested men reported higher levels of cancer risk perceptions (breast cancer included) when the mother was diagnosed with or died from breast and/or ovarian cancer. The experience of cancer within the family impacts on family members' cancer risk perception (Bradbury et al., 2009; Young et al., 2017), supporting the idea that the formulation of cancer risk perception is impacted by both cognitive and emotional factors (Hopwood, 2000). It is also interesting to note that our results, contrary to expectations, show that men with children exhibit higher levels of perceived breast cancer risk and higher intentions to adhere to CS. Our hypothesis is that younger men, who are less likely to have offspring, are likely sons of BRCA1/2 carriers and thus have direct experience cancer within their families. Future studies could verify these results by exploring the role of the type of relationship/kindship with the carrier in the perception of risk and the intention to adhere to CS.

In terms of CS uptake, our findings revealed that approximately 10% of the participants underwent genetic testing at the Division of Cancer Prevention and Genetics of the IEO. It is worth noting that some individuals may have undergone testing at a different institution. Considering the typically low adherence of men to genetic testing in this context, this partial result can still be viewed as promising.

Limitations

Despite the strong theoretical background applied in the present research and the longitudinal design, some limitations should be noted. Limitations of this study include the self-selection bias that could have affected the sample, particularly because the available carriers were involved in contacting their male FDRs. It might be that the BRCA1/2 carriers who agreed to participate in the study, were the most willing to share health information with their male relatives and the most willing to involve them in the PV identification process, as were the men who decided to participate in the study. In this regard, a limitation is the inability to assess the exact content of the disclosure to FDRs, about the research study. Moreover, although there is a proven link between intention and planning, and between planning of the action and the action itself as suggested by Schwarzer (Schwarzer & Luszczynska, 2008), data on the action itself were not

completely collected, as requested by the IRB of the IEO. However, 10% of our participants once involved in the study decided to schedule genetic testing at our division. We have no information on participants who, for logistical reasons, may have chosen to contact other Institutions. Considering that the enrolled population came from all over Italy, it is plausible to think that other participants made contact with facilities closer to their area of residence. However, future studies should verify these findings. The previous level of knowledge about BRCA 1/2 genes and genetic testing was not assessed. Participants' awareness of the implications connected to the BRCA 1/2 PVs may have influenced their intention to adhere to CS. Furthermore, as reported also by Annoni and Longhini (2022), negative outcome expectancies (e.g.: "knowing to be a carrier of PVs in BRCA1/2 would cause me stress and cancer worry") may operate in concert by balancing positive expectations, representing significant barriers to screening adherence. Future studies should investigate barriers and potential facilitators to screening adherence to propose useful strategies to overcome them.

Chapter 4. A multi-level analysis of barriers and hypothetical promoting factors to CS for men: a qualitative study

4.1 Introduction

In the context of personalized medicine, the implementation of genetic testing could be considered an actionable strategy to improve population health, not only for the treatment of diseases but also for early detection and prevention (Roberts, Dotson, et al., 2018). Identifying PVs has several implications for both the index patients (first identified case of genetically transmitted condition in a family; also called proband) in timely managing the high risk of disease reducing long-term morbidity and mortality, and also for carrier's family members. The critical process of disseminating risk information to blood relatives at high risk for the identified condition, and the subsequent family members' uptake of the genetic testing, is known as CS. Several clinical guidelines recommend offering CS for testing at-risk relatives in a specific order, based on the likelihood that they will test positive (American College of Obstetricians and Gynecologists, 2018).

To date, in the cancer domain one of the most common HCs, along with Lynch Syndrome, is the Hereditary Breast and Ovarian Cancer Syndrome (HBOC), and particular attention has been given to CS for this frequent autosomal dominant condition (Garutti et al., 2023). HBOC syndrome is a condition most commonly caused by PVs in BRCA1 and BRCA2, and the implications for both men and women of these PVs were discussed extensively in Chapter 1. However, despite the several benefits of CS in terms of cost-effectiveness and of allowing at-risk relatives to pursue appropriate cancer screening and risk reduction strategies (Roberts, Dotson, et al., 2018), testing uptake is relatively low and this genetic condition remains underdiagnosed, in at-risk men particularly (Lieberman et al., 2018; Roberts, Dotson, et al., 2018).

Literature suggested that several factors may explain the low uptake of CS by relatives, identifying barriers (factors that prevent or hinder implementation or adherence to the guideline) or facilitators (factors that, by their occurrence, promote implementation or adherence to the guideline). The major barriers to CS included low

knowledge or understanding related to CS for both proband and family members, suboptimal communication between proband and family members, poor attitude and knowledge of providers and thus poor indication to pursue genetic testing, and geographic and logistical barriers to obtaining genetic services, as well as the emotional state of the proband or family members that affect their attitude and predisposition. Coversely, the most frequently mentioned facilitators to CS uptake were a high education level, being a female and an FDR of the affected proband, marital status, a desire to know more about one's children's risk and concerns about the relatives, a personal history of disease or risk factors, and the physician recommendation or direct contact of the relatives from the provider (Roberts, Dotson, et al., 2018; Srinivasan et al., 2020). Furthermore, in a recent systematic review of barriers and facilitators for CS in genetic conditions, Srinivasan and colleagues (2020) categorized barriers and facilitators by

identifying various interconnected systems that mutually influence one another, thereby impacting the actual enactment of the CS uptake. Specifically, the review identified barriers and facilitators operating at different levels: a) individual level (such as knowledge or attitudes, beliefs, and emotional responses of the relatives), b) the interpersonal level (considering the familial communication and the provider factors), and c) the environmental level (such as the accessibility of genetics services). This comprehensive categorization shed light on the multi-dimensional nature of barriers and facilitators in the context of CS within genetic conditions. It is worth noting that the findings from the systematic review encompassed various genetic conditions, each of which exhibited distinct characteristics and psychological impacts on both carriers and their relatives. However, there remains a gap in our understanding of the specific factors that either impede or promote CS uptake in at-risk men within BRCA-positive families.

As shown above in Chapter 3., the results of the RCT longitudinal study partially support the application of the HAPA model as a valuable model in understanding men's adherence to CS in HBOC, suggesting the idea that also other factors may play a crucial role and interfere with or promote CS adherence. Thus, starting from this theoretical background (Schwarzer & Luszczynska, 2008), the primary endpoint of the study was to conduct a multi-level analysis of the barriers and promoting factors that may influence adherence to CS for male FDRs of female BRCA1/2 carriers, considering the experience of not yet tested men.

4.2 Materials and Methods

Recruitment and procedure

All study procedures were subjected to rigorous ethical scrutiny and received approval from the Institutional Review Board of the IEO, with the approval number R1249/20-IEO 1314. The recruitment process began by contacting female probands who were part of the register of individuals carrying pathogenic or likely PVs in the BRCA1/2 genes, as identified by the Division of Cancer Prevention and Genetics (IEO) from 2010 to 2023. These probands were contacted via phone or email to explain the research objectives and procedures. They were also requested to share the research information with their male FDRs and invite them to participate in the research study. For those male FDRs who expressed an interest in participating, a researcher initiated contact and provided them with an information sheet detailing the study. Subsequently, email addresses were collected, and participants were invited to engage in a 30-40 minute interview. Before participation, all individuals provided informed consent, thereby ensuring their full understanding of the research process and their voluntary involvement in the study.

Participants were eligible for inclusion if they were male, at least 18 years old, and had at least a first-degree family member (i.e., mother, sister, or daughter) affected by BRCA1/2 PVs, meaning that participants presented a 50% chance of being carriers themselves. In addition, participants were excluded if they did not read or speak Italian, had a personal cancer history, or had already undergone a genetic counseling session for HCSs.

There was no relationship between researchers and participants before commencing this study. Participants involved in the study did not receive any incentives for participating in this research; however, at the end of the interview, they were given the opportunity, if they were interested, to fill out a more detailed familiary history questionnaire that would allow them to be placed directly on the waiting list for genetic counseling and testing, without the need to contact the Division of Cancer Prevention and Genetics (IEO). On the other hand, in case they were interested in undergoing a genetic test at another institute, contacts and references of facilities in the area closest to their residence were given.

The qualitative interviews were administered by the main author, a female Ph.D. student specializing in System Medicine and trained in qualitative research methods.

Despite offering participants the choice of in-person or virtual interviews, all interviews were conducted via virtual means. Participants were not provided with the interview questions in advance. The interview sessions ranged in duration from 23 to 71 minutes, with an average duration of 42.6 minutes. These interviews were audio-recorded and subsequently transcribed in their entirety for the purpose of coding and analysis. To ensure confidentiality, participants' data were pseudonymized using unique ID codes, comprising a combination of letters and numbers. Overall recruitment occurred from November 2022 to March 2023.

Participants

In total, forty-five male FDRs of female BRCA1/2 carriers (N=32) were we reached out via telephone or email and were proposed for the study. Out of these individuals, twenty-one expressed interest and consented to take part in the study, resulting in a response rate of 46%. However, it is important to note that five subjects had already undergone genetic testing, three had received a prior cancer diagnosis, and two participants resided abroad, making it unfeasible to include them in the study.

The final cohort of participants involved eleven (N=11) male FDRs of female proband, with ages ranging from 32 to 69 years old (*M*=48.36, *SD*=11,45). All participants self-identified as belonging to the white ethnicity. The majority of participants had high education levels and had attained at least a high school education, lived in the North Central of Italy, and held white-collar employment positions. Regarding their degree of kinship with the proband, they were brothers or sons. More than half of the participants were married and with offspring, ranging from 1 to 2 children. All the proband were affected by breast or ovarian cancer and discovered the PVs between 2013 and 2021, as reported by the male relatives. For a comprehensive overview of the demographic characteristics of the study participants, please refer to *Table 1.*

Table 1. Demographic characteristics of the study participants (N=11)

ID	Age	Educational level	Degree of kinship	Marital status	Parental status	PVs at-risk for
ID1	54	High School Diploma	Son and brother	Married	2 daughters	BRCA2
ID2	35	University Degree	Son	Married	-	BRCA2
ID3	52	University Degree	Son and brother	Married	1 son	BRCA2
ID4	69	High School Diploma	Brother	Married	1 daughter and 1 son	BRCA1
ID5	60	University Degree	Brother	Single	-	BRCA2
ID6	37	High School Diploma	Son and brother	Divorced	-	BRCA2
ID7	32	University Degree	Son	Single	-	BRCA1
ID8	53	High school diploma	Son	Married	1 son	BRCA2
ID9	53	High school diploma	Son and brother	Married	-	BRCA2
ID10	48	University Degree	Brother	Divorced	-	BRCA1
ID11	39	University Degree	Son	Married	1 daughters	BRCA1

Measures.

Participants were asked about socio-demographic characteristics, such as age, race/ethnicity, marital status, educational level, presence of children, degree of kinship with the proband, type of PVs at risk for and personal history of cancer or chronic disease. The interviews were semi-structured, making use of a topic guide with various prompts, allowing the researchers enough structure to understand participants' points of view, while still allowing participants to feel free to express their opinions on the topic.

Interview questions were designed broadly to understand men's experiences with hereditary cancer risks; questions on the topic guide covered knowledge about BRCA PVs and genetic testing, decision-making process about BRCA1/2 genetic testing, and facilitators/barriers to CS uptake. *Table 2* shows the qualitative interview guide.

Table 2. Qualitative interview guide

Key Questions	Probes
• In your own words, what is a hereditary cancer syndrome? • What do you know about BRCA1/2 gene mutations? These are also called BRCA1/2 pathogenic variants, or positive results for the BRCA1/2 gene. • What do you know about genetic testing?	• What are your main thoughts and feelings about this condition? • How do you see your cancer risk?
• What are your thoughts about getting BRCA genetic testing? • Why have you not yet undergone BRCA genetic testing?	• Is this something you have considered before today? • How do you feel about the decision not to have undergone BRCA genetic testing yet?
• Which factors would you consider in deciding to undergo or not undergo BRCA genetic testing? • What would make you more likely to get BRCA genetic testing?	• What would help you to get testing? • Please share the possible reasons why you consider "_____" (repeat what the interviewee said)

• Please tell me about any discussions that you have had with your family members about BRCA genetic testing • Have any of your doctors talked to you about BRCA genetic testing? Tell me more about that.	

Data Analysis

The data analysis process was carried out by a team of four highly experienced researchers in qualitative research, each with diverse backgrounds, including psychologists and genetic counselors. These researchers independently reviewed all the interview transcripts multiple times. As three out of the four analysts were native English speakers with no proficiency in the Italian language, the transcripts from the semi-structured interviews were translated into English. The accuracy and fidelity of these translations were subsequently verified by another researcher who was not involved in either the translation process or the subsequent analysis of the interviews. A qualitative Thematic Analysis was performed, and the main themes or patterns were identified with a) a mostly semantic approach, i.e. within the explicit or surface meanings of the data without looking for anything beyond the participant's words, and b) a deductive or "top-down" approach, starting from the HAPA theoretical background (Boyatzis, 1998; Braun & Clarke, 2006; Hayes, 1997). This method of analysis allowed the identification of the main themes of participants' experiences by focusing on the internal psychological meanings that emerged from the transcripts and tended to provide a detailed analysis of some aspects of the data, starting from a strong theoretical background. By Braun and Clarke's model (2006), the initial data coding and codebook were conducted and developed by all the coders together, analyzing the content of the first transcripts. Furthermore, an iterative procedure was used to finalize the codebook whereby independent coding of the same ten transcripts was completed by two coders: the primary coder (Ph.D. students) and the reliability coder (genetic counselor). Coding discrepancies were discussed and resolved in collaboration with the other two researchers until an agreement was reached. The finalized codebook was used by the

primary coder to recode/re-examine all coded segments. In the final phase, codes were organized in the theme/subtheme of reference and a thematic map was reached. All authors reviewed the thematic map in the final phase. To further validate the thematic map, one author who did not participate in the previous analysis reviewed the entire process and the identified themes. Thus, repeated meetings among researchers allow the identification of codes and themes. Men's quotations were coded using participants' ID numbers and quotes reported were chosen from excerpts of text marked as emerging themes.

4.3 Results

The results of the qualitative data analysis are presented in this section. According to Hannah and Lautsch (2010), results are presented using a non-numerical form. Participants reported that different barriers contribute to disincentivizing their adherence to CS. They suggested some potential promoting factors that could make it easier and more likely for them to adhere to CS. Following the way the data were coded, the results were grouped under two major sections a) barriers and b) hypothetical promoting factors. For each section, the categories identified by the HAPA model (risk perception, self-efficacy, and outcome expectancies) and others, influencing the decision-making process, have been presented. Furthermore, the results for each identified category were presented based on multiple levels of analysis, depending on whether the codes refer to the individual, interpersonal, provider, and environmental levels.

4.3.1 Barriers

For illustrative quotes about barriers to CS uptake for male FDRs, please see *Table 3*.

Risk Perception

The majority of the participants included in the study addressed the theme related to their own cancer risk, with different degrees of awareness, about the decision to CS uptake. Specifically, several recurrent barriers have been identified as affecting men's personal risk perception.

- Individual Level
    - **Low level of knowledge/ inaccurate knowledge.** Out of the eleven

participants, only two had awareness of the specific PVs associated with their heightened cancer risk. A majority of the participants expressed inaccurate knowledge, particularly regarding the organs at an increased risk of cancer due to these PVs. Intriguingly, individuals perceived cancer risk for organs that held personal or familial significance or were emotionally evocative to them, even though these organs were not typically associated with BRCA1/2 PVs. For instance, a participant who smoked associated the PVs with an elevated risk of throat cancer, while another participant with a family history of gastric disease incorrectly linked stomach cancer to BRCA carriers' heightened risk. Inaccurate knowledge was also found concerning the inheritance patterns and the transmission of these conditions across generations. An example of a response that reflected a more inaccurate understanding was *"Yes also because if a parent has the mutation, I get the 50% chance that either I have it or clearly the other 50% chance that my brother has it.. one of the two"* (ID2).

- **Low perceived susceptibility/vulnerability to the mutation's effect.** Several participants emphasized their low subjective perception of the risk associated with acquiring the PVs, as well as the risk of developing cancer even if the PVs were to be detected. They appeared to regard this issue as something that did not directly impact them. For example, *"I am fine, I'm well.. I say... I don't have the perception that this mutation could have an impact on my body, for now. I don't perceive the danger as imminent here.."* (ID8).
- **"Healthy" status**. Participants frequently mentioned their good health and the absence of cancer or other medical conditions as sources of reassurance. This sense of being healthy and unaffected led them to perceive themselves as not directly involved in the issue of genetic testing, as if the relevance of this decision was contingent upon the presence of the disease. *"To me objectively is too much. because I feel like I'm decently healthy, I am fine…[...] That is, if I would say yes to being tested, then there would be the whole issue that then I would have to undergo probably a whole series of other medical check-ups, and so on. But I am fine, I'm well…I don't need it!* (ID8).

- **“Female matter”.** Interestingly, participants tended to associate BRCA1/2 PVs exclusively with the female gender and the maternal side of their family lineage. While many of them acknowledged the presence of certain cancer risk factors within their family, being male was often perceived as a protective factor. This gendered construction of breast cancer as a disease primarily affecting women, along with the general perception that these mutations were a concern exclusive to females, emerged as significant barriers to the uptake of genetic testing for BRCA1/2 PVs among men. For example, one participant said, *“I know that more or less we're talking about a mutation that increases the risk of having breast and ovarian cancer, and I confess that then I never really investigated properly... because on the male lineage from what I understand, there is less risk, or maybe even almost no-risk at all.. because we don’t have these organs.. in fact, I didn't get tested!”* (ID5).
- **“I already feel/perceived myself at high risk”.** Due to their extensive family history of cancer, participants frequently saw themselves as belonging to a high-risk category for cancer. However, in certain instances, participants expressed how this sense of being at risk led them to live as if they were already carriers of the PVs. This involved proactively undergoing regular medical check-ups in accordance with clinical guidelines. Paradoxically, feeling like a carrier appeared to act as a deterrent to the decision to undergo genetic testing, *“And in fact, I always thought, "Okay, I'll start checking since my 40s, even if I can't get tested, I'm still more or less in line with what the prescriptions of positive results says"* (ID6).

- Interpersonal Level
  - **Perception of risk for diseases in the male relatives.** Numerous participants contemplated the heightened risk they perceived for the disease that had affected the male members of their family, or more broadly, their male relatives. This observation underscores the notion that the concept of "masculinity" plays a role in shaping their individual risk perception. One participant said, “*The point is that being 69 years old this year, I have already lived 5 years longer than my dad... because dad died of esophageal cancer at the age of 64... that's why I am worried*

about the intestines or the gastrointestinal tract.. not about cancer that affected my sister or my mom!" (ID4).

- **"The carrier is still alive"**. A few participants emphasized the perceived low seriousness of cancer, referring to few consequences associated with that cancer diagnosis as if it was not something to worry about given the limited impact on survivability. For example, *"In my head breast cancer is not a serious cancer because you heal... it doesn't have the seriousness, the rank of serious cancers.... You heal too much to be a tumor, i.e. tumor = dead to me... that's the idea! And my sister is still alive"* (ID1).

- Providers Level
  - **Lack of Provider recommendation**. Several participants expressed their reflection on the absence of direct communication or recommendation from healthcare providers. They held the expectation that if the issue was pertinent and posed a significant risk to them, healthcare providers should have proactively provided information and guidance regarding the option of undergoing genetic testing. One participant said *"The fact that you don't ask me to get tested reassures me in that sense; If I do the interview and you don't ask me to undergo the test, that reassures me that I don't have direct problems, that I am not involved in short here.."* (ID5).

Negative Outcome expectancies

Outcome expectancies, typical in rational decision-making, represent what to expect from enacting a given behavior. Negative expectations, or the cons of the behavior, represent barriers to the implementation of that behavior. Specifically, several negative expectations interfere by acting as deterrents concerning undergoing genetic testing in men.

- Individual Level
  - **Concern about adverse psychological sequelae.** Participants shared a range of hypothetical and anticipated negative emotions associated with the prospect of undergoing genetic testing. All participants expressed fears or negative emotions when contemplating the test, envisioning the test result as "positive," meaning it would confirm the presence of PVs. These negative emotions included heightened concerns about cancer,

anxiety, anticipation of regret due to potential adverse impacts of the information, burden of the information, and fear of the implications it might carry. The idea of knowing to be carriers, thus exposing themselves to the risk of developing cancer, was viewed as an "emotional burden" in the lives of these men, which they believed would hinder their personal goals and plans. *"Especially what I haven't said yet... which is the most important thing maybe, is the anxiety... that is, it still puts a lot of anxiety on you... that is, knowing that you are more at risk of a disease puts you in a state of anxiety, which maybe then you get over a little bit but in short... I don't know.."* (ID5). And again, *"I was probably a little bit scared of the idea of knowing that I could have this mutation too...as if knowing this thing would affect me in certain aspects of my life; because let's say it is an important extra thought that you have in your head in short, considering the fact of undergoing preventive medical checkups"* (ID7).

- **Limited knowledge of risk management post-testing**. A significant number of participants acknowledged having limited or inaccurate knowledge regarding the implications of receiving positive test results. This included uncertainties about the recommended follow-up checks, the frequency of these checks, and which organs should be monitored. One participant said, *"I don't know what it actually entails; I think of the in-depth medical check maybe, going to monitor maybe more frequently certain areas, certain organs maybe just to avoid the onset maybe of something.. I don't know if annual check-up or more.."* (ID2).
- **Responsibilities toward their health status.** Numerous participants regarded genetic testing as a "wake-up call". They believed that such testing would compel them to heighten their awareness of their current behaviors and would force them to make changes in their habits. This, in turn, would make them feel more accountable for their health condition and overall well-being. For example, **"***Rather, of course, knowing that I have the mutation a little bit would destabilize me...that's true, I can't say no...yes it would be a big wake-up call for me"* (ID3).
- **Perceived medical overtreatment/over-screening**. Frequently, participants anticipated the potential consequence of medical

overtreatment or excessive screening if they were to receive positive test results. This concern reflected their apprehension that a positive result might lead to unnecessary medical interventions or over-monitoring of their health. For example, *"Maybe it is not the best to go to hospitals, to be hospitalized, to check yourself all the time…Now I check myself, but I don't do it excessively!"* (ID2).

- **Direct link between mutation and cancer**. Genetic testing has been consistently linked in participants' minds with positive test results. Moreover, these positive test results are often perceived as equivalent to a direct cancer diagnosis. This perception highlights the profound impact that a positive genetic test result can have on individuals, with the anticipation of the result itself being intertwined with the notion of a cancer diagnosis. One participant reported *"And also voluntarily I never wanted to go into it with mom also a little bit for that reason there, because it agitates me... because I think about having cancer directly, about being sick!"* (ID11).
- **No trust in prevention/no perceived benefit**. Certain participants conveyed limited or minimal confidence in the potential for preventing cancer, which significantly influenced their perception of the benefits associated with genetic testing. Paradoxically, these participants acknowledged the benefits of genetic testing for women, primarily due to the potential for early intervention through risk-reducing surgical strategies. For example, *"I have to say, from my very personal point of view, it is not that I believe in it very little, but I think that for prevention you do what you can do. then in fact it is very difficult to do real prevention.. we were talking about predictive tests, yes in short they can set off some wake-up call for you, but however you already know, having seen the history of your parents and your relatives... you more or less know where to look out for!"* (ID5).

- Interpersonal Level
  - **Anxiety/Fear for the health status of the proband.** Some participants expressed concerns regarding the contingency between communicating genetic test results to family members and the progression of the carrier's cancer treatment. They viewed this connection as a deterrent to

undergoing testing, primarily due to the apprehension and fear stemming from the impact of the carrier's disease on their family members. For example, *"My sister's cancer visits, a whole series of aspects that were intertwined with everyday problems! How much more so? That is, I relive it as something that actually can be considered as something that further frightened me... that is, that even there, the anxiety clearly of my sister"* (ID9).

- Providers Level
    - **Lack of risk-reduction strategies for men**. The restricted options available for managing the elevated risk in men, coupled with the absence of risk reduction strategies specifically tailored for them, were cited as factors that deterred some individuals from considering CS uptake. For example, *"I guess for example that for men one sensitive area is the prostate... But I unfortunately have many friends and acquaintances who have had prostate problems and cancers.. but if you know even before, that you're at risk for prostate cancer, there are not many avenues.. except for doing a PSA every 6 months.. but you know that it is not always very helpful!"* (ID5).
    - **Inaccurate knowledge related to the testing procedure.** The majority of participants exhibited a lack of clear knowledge regarding the genetic testing procedure. Frequently, they conceptualized the procedure as complex, challenging, and invasive, often conflating it with therapeutic interventions undertaken by individuals during their cancer treatment process (such as surgical tissue removal). This lack of clarity about the genetic testing process contributed to their apprehensions and misconceptions about the procedure. One participant reported *"It comes to my mind that it is something that you take from the marrow for example, I don't know. something that has to hurt you because it is something serious...it has to hurt! It can't be a simple thing if you have to get DNA out of it"* (ID1).

Self-Efficacy

Perceived self-efficacy portrays individuals' beliefs in their capabilities to exercise control over challenging demands and over their own functioning. Those with less self-

efficacy tend to procrastinate and imagine failure. Few barriers affected self-efficacy at the individual level.

- Individual Level
    - **Avoidant coping strategies.** A majority of the participants indicated a strong tendency to employ avoidant and distancing coping strategies when dealing with health information, primarily as a means to manage the inherent uncertainty and maintain emotional equilibrium when confronted with such information. For example, one participant reported *"And honestly, as far as I'm concerned, I put that information aside, also because one, mmm. I prefer to not think about it! I mean, I always know that there's this thing that is above us... that we might get involved in! But specifically, I haven't delved into it!"* (ID11).
    - **Procrastination.** Some participants described a proclivity for procrastination and delaying healthcare-related decisions as part of their approach or attitude toward managing health matters. *"If I have to decide and say" I'm going to call now and get tested" I'll never get tested...if instead, we make an appointment now, and let's say on X date you get tested, then I'll do it"* (ID3).

Others

Participants reported various additional factors and barriers beyond those identified by the HAPA model, which played a significant role in influencing their decision-making process regarding CS uptake.

- Individual Level
    - **Demographics.** Participants reported that some socio-demographic variables, such as age, affected the relevance of the theme. For example, one participant said *"I'm young, I don't think it is something that concerns me directly....and my age leads me meanwhile to be very busy on other things"* (ID2).
    - **Competing life concerns**. Many participants cited competing life issues or concerns as significant barriers to their pursuit of genetic testing. These other life challenges and priorities often took precedence, causing delays or hesitation in addressing genetic testing. For example, *"Yes, I had thought about it...but it was not an easy thing, because you still had*

to go to Milan at the very least ...and partly because of work, partly because of family problems the talk got lost!" (ID4).

- **Fatalistic attitude-fatalism**. The feeling of not being able to control the occurrence of events in one's life and the attitude of not taking action were reported by some participants as barriers to preventive behaviors. For example, *"I have my own whole view on my end, so ... I do very little prevention.. I am fatalistic!"* (ID8).
- **Reluctance about medical check-ups**. The majority of participants acknowledged their general reluctance toward medical check-ups, which extended to seeking genetic testing. This reluctance played a significant role in shaping their decision-making processes, acting as a key barrier to pursuing healthcare assessments and preventive measures. For example, *"I have never had a colonoscopy, despite in short I have it here in the nursing home, where I work. I have a friend doctor who prescribed me several times the preparation to do, I also had the appointment... afterward, I never did it though, but I think sooner or later I will do it"* (ID4).
- **Low levels of self-care**. A few men participating in this study exhibit low levels of self-care, describing the enactment of several risky behaviors (such as smoking, and risky eating habits) of which they show awareness and do not seem intent on changing. *"Then, I smoke a lot ... and from that point of view for example I should stop smoking, out of respect for my wife, my son, and so on. But I don't do this thing even, so what am I talking about? If I don't take even the slightest care of myself!"* (ID8).

- Interpersonal Level
  - **Lack of communication.** Several participants highlighted the lack of communication between family members, particularly between female carriers and their male relatives. This breakdown in communication was noted as a significant challenge in the context of discussing genetic testing results and related health matters within families. *"With my sister no, I never stopped with her...I don't know, the thing of sitting down for a moment and saying, "What are you doing? What did they do to you? What's the implications for me?"* (ID9).

- **No other relatives tested**. Certain participants reported experiencing a negative social influence stemming from the fact that none of their other significant relatives had undergone testing for PVs. This lack of testing among relatives appeared to impact their own decision-making process regarding genetic testing, potentially creating doubts or hesitations. For example "*We are four boys and two girls and to my knowledge, no one has been tested...I haven't asked anyone in the family anymore, but a while ago still no one had been tested!"* (ID3).

- Providers Level
  - **Lack of communication and confidence in providers' knowledge about genetic testing.** The overwhelming majority of participants indicated having had minimal or no discussions with healthcare providers or primary care physicians about their familial genetic risk. Some participants expressed a lack of confidence in their doctors' competence in addressing this matter, perceiving it as a highly specialized and complex issue beyond the scope of general healthcare providers. For example, *"I mean I would want to talk to a doctor who knows about it... because when my sister got tested it was just something that no one knew about, I mean the stuff you read about in the papers because Angelina Jolie was there but very little was known about serious things! But there are no geneticists where I am living"* (ID5).
  - **Time-consuming or difficult procedure.** Several participants described the genetic testing procedure involving a blood draw as a complicated and time-consuming process. This perception of complexity and the perceived investment of time and effort were factors that negatively influenced their decision-making regarding genetic testing. One participant said *"I mean that it was possible to do it like you do the blood draw, that one could book it online, then go a handful of miles from home without having to take maybe two days for vacation, rent a hotel room and everything.. it would be much more practical for me*" (ID6).

- Environmental Level
  - **Accessibility of genetic testing.** Numerous participants highlighted significant logistical barriers to CS uptake. These barriers included difficulties in reaching the hospital for testing, especially since some

participants perceived testing as limited to the same institution where the carrier had received their diagnosis or had been tested. Additionally, living at a distance from the carrier or the carrier's hospital posed challenges to accessing CS, contributing to the barriers encountered in pursuing the test. It has been reported *"Buth, I lived in England a few years when mom was not well... and so let's say I had in the last few years a very full life! Plus I was living at a distance, and it wasn't exactly super easy to deal with these things... because of a logistical issue!"* (ID10).

Table 3. Barriers to CS uptake for male FDRs

Theme	Level	Subthemes	Exemplar quotations
Risk Perception	*Individual level*	Low level of knowledge/ inaccurate knowledge	It may be the throat because my sister said "Be careful because in any case, you probably as a male don't have the same risk that I have, and that I could transmit to my daughter. But even on the male side, there might be some risk"...now I remember this throat risk so.. (ID9)
		Low perceived susceptibility/ vulnerability to the mutation's effect	..I am fine, I'm well. I say... I don't have a perception that this mutation could have an impact on my body, for now. I don't perceive the danger as imminent here.. (ID8)
		"Healthy" status	..honestly, I don't even know exactly why I decided not to do it.[...].. as long as it doesn't affect me directly then it is better that I don't deal with it, I mean, in the end, I'm healthy.. I'm fine, I didn't feel it was something that affected me. (ID10)
		"Female matter"	.. maybe the test would be more useful for my daughters rather than me.. because they are more interested in the topic, having all these people in their family with breast cancer (ID1)
		"I already feel/perceived myself at high risk"	..there is something that scares me, maybe because I suppose I am already part of that "at risk" category (ID10).
	Interpersonal level	Perception of risk for diseases in the male relatives	..the mutation comes from mom, but the thing that I perceive the most, that touches me the most is the whole picture of my uncles, grandparents (from paternal line), and so on who died of prostate cancer...because male-male.[..] Yes, because that's the thing that I perceived... and I perceive physically... (ID1)
		"The carrier is still alive"	That is, in the end, both of them, mom and aunt, had cancer in both breasts. My aunt also had intestines cancer but they are still alive. I mean so they are not "bad" memories for me (ID6)

	Provider level	Lack of Provider recommendation	..if I do the interview and you don't ask me to undergo the test, that reassures me that I don't have direct problems in short here.. (ID5)
	Environmental level	/	/
Negative Outcome Expectancies	*Individual level*	Concern about adverse psychological sequelae	..I also thought about it for a long time whether to do it or not to do it...but then I decided not to do it! Maybe out of fear, I have to say [...], there is something that scares me, maybe because having medical confirmation you always have this mental input "You are a person at risk, you are a person at risk". I am afraid that might influence my thoughts negatively. (ID10)
		Limited knowledge of risk management post-testing	..I know the implications, so maybe having to sustain some treatment or change some eating habits and my lifestyle, or taking some drugs… (ID11)
		Responsibilities toward their own health status	..certainly having that information would make me responsible. Then I knew I would have to do something with it to change my lifestyle (ID2)
		Perceived medical overtreatment/over-screening	Because I'm always afraid that it is then a "Pandora's box," and that there would be something to do...surely something would come up, surely by doing some kind of general diagnostic tests, surely there would be something to do to correct my life.[...]that is, if I were to just change my habits, maybe eating or smoking, etc. they would be just the minimum, but maybe then it would go on to therapies, to more important things... and to me objectively is too much .. because I'm decently healthy (ID8)
		Direct link between mutation and cancer	And also voluntarily I never wanted to go into it with mom..also a little bit for that reason there, because it agitates me... because I think about having cancer directly, about being sick (ID11)

		No trust in prevention/no perceived benefit	you know, unlike me, I see my uncle (my father's brother) who has always done checkups, and anyway, he also had prostate cancer that now they are still keeping under control..[..] I mean I think that the genetic test, yes, would give me information, but I don't think it would turn my life upside down anyway. Because I don't perceive danger for me and benefit (ID4)
	Interpersonal level	Anxiety/ Fear for the health status of the proband	With my sister we talked about her visits, a whole series of aspects that were clearly intertwined with everyday problems. That is, I relive it as something that actually can be considered as something that further frightened me...that is, even there, the anxiety clearly of my sister. (ID9)
	Provider level	Lack of risk reduction strategies for men	She had also said to me that a positive result in men does not lead to a solution to the problem, it simply leads to the awareness of having to do checkups, to keep yourself under control, maybe not from the 50 years but from the 40 years.(ID6)
		Inaccurate knowledge related to the testing procedure	...probably it is something that you take from the marrow, for example, I don't know. something that has to hurt you because it is something serious...it has to hurt! It can't be a simple blood draw if you have to get DNA out of it... (ID1)
	Environmental level	/	/
Self-Efficacy	*Individual level*	Avoidant coping strategies	from what concerned diseases and so on, I always avoided the theme.[...] Maybe I'd rather be ignorant than to get to the bottom of things...maybe because of a little superficiality. I do it in every context, so then it also invests specifically what we're talking about (ID5)
		Procrastination	I stall in decisions... I postpone decisions... not in everything, however in health things, I do that a lot... if I know I have to undergo a medical check, maybe sometimes I stall and wait from week to week, month to month sometimes (ID3)

	Interpersonal level	/	/
	Provider level	/	/
	Environmental level	/	/
Others	*Individual level*	Demographics	in the sense that my age leads me meanwhile to be very busy with other things, other aspects of life.(ID2)
		Competing life concerns	Let's say that in the last few years, my mind has been a bit occupied by other thoughts, between COVID-19, the radical change in lifestyle, and work... genetic testing has not been a priority for me in the last few years (ID7)
		Fatalistic attitude-fatalism	I also refer to the mutation...it is luck or bad luck to have it or not to have it. I let time pass… Also because let's imagine that we do the test, we find out that I don't have the mutation... but after a year I could still find cancer in my body... and the same thing in reverse, that is, I could have a mutation and not have cancer the next year.. (ID3)
		Reluctance about medical check-ups	ID7: You think my last blood draw, I think it was around 15 years ago.
		Low levels of self-care	Then, I smoke a lot ... and from that point of view for example I should stop smoking, out of respect for my wife, my son, and so on. But I don't do this thing even, so what am I talking about? If I don't take even the slightest care of myself.(ID8)
	Interpersonal level	Lack of communication	With my brother we talked about it a couple of years ago... then my brother I don't know now what position he has regarding the test, we haven't talked about it again, and we haven't had a chance more than anything else (ID2)

	No other relatives tested	We are four boys and two girls and to my knowledge, no one has been tested...I haven't asked anyone in the family anymore, but a while ago still no one had been tested.... (ID3)
Provider level	Lack of communication and confidence in providers' knowledge of genetic testing	.. I never talked to the general practitioner about it either, I don't know if I should talk about it... but in my opinion, he doesn't know much, it seems like a very specific thing to me this…(ID2)
	Time-consuming or difficult procedure	I remember I had said, "But if I wanted to do the genetic mutation test, let's not have them hospitalize me somewhere like I have to do a night out!" I don't want it to be a hassle, I don't want to waste too much time. (ID2)
Environmental level	Accessibility of genetic testing	Personally, I never inquired about the genetic test because for me to do any kind of test is so uncomfortable. For example, visiting (hospital name) takes almost two days to travel from here. Getting to (Hospital City) is six hours one way and six hours back, more or less.

4.3.2 Hypothetical Promoting Factors

For illustrative quotes about hypothetical promoting factors to CS uptake for male FDRs, please see *Table 4.*

Risk Perception

Several factors have been identified as positively influencing men's cancer risk perception, promoting their intention to uptake CS.

- Individual Level
    - **Stage of life.** Several participants emphasized reaching certain age thresholds as a significant and impactful point in time for their risk perception, impacting their intention to enact preventive behaviors such as undergoing genetic testing. For example, *"..then in short with advancing age you also begin to ask yourself a little more questions concerning your health, you say to yourself "maybe I should start doing this kind of checkup as well," "ah this exam I never did"* (ID7).
    - **Personal history of risk factors/disease.** The presence of other risk actual risk factors or health issues represented an important turning point in changing one's intention in CS uptake. One reported *"The recent changes in my health status move me to rethink about the possibility of getting tested!"* (ID10).
- Interpersonal Level
    - **Concern for the health of other family members**. Interestingly, only one participant reported concerns for the health status of the offspring, both son and daughter. The participant reported *"..when it unfortunately touches you because you have sisters and father who have had cancer, it is clear then that it interests you a little more ... that's why I am worried about my children's health status, not about me"* (ID4).
    - **Carrier's death**. Carrier's death represented an impactful event from a psychological point of view in the participant's life, moving toward considering the possibility of undergoing genetic testing. One participant said *"Also because my mom as I said, died... so anyway it is not really a thing to underestimate... it is an important thing, not to underestimate it.."* (ID8).
    - **Communication with carriers about male risk**. Few carriers

communicated with male relatives about their personal cancer risk, as reported by participants. However, the communication process, when present, has been identified as a relevant factor in promoting awareness of being at risk. *"My sister said to me "be careful because in any case, we are a family and we are all involved in this thing because there is something that runs in our family. Even on the male side, there might be some risk""* (ID10).

Positive Outcome Expectancies

Positive outcome expectancies associated with genetic testing represented the pros of that action. Several positive outcome expectancies may act as promoting factors for the uptake of CS.

- Individual Level
  - **Trust in medicine/research.** The majority of the participants described their general confidence and trust in medicine/research as a useful facilitator to consider taking genetic testing. One participant said "*My only motivation has always been logistical, also because I personally have always had enough faith in medicine, even in recent events. I mean for better or worse, if you don't trust doctors who should you trust basically?"* (ID6).
  - **Knowledge about the link between genetic testing and prevention**. Participants who described being aware that genetic testing offers an opportunity to do prevention more deeply, and thus to early identify cancers, were more likely to consider undergoing the test. The possibility of being able to intervene and "do something" through prevention was described by some participants as counterbalancing the emotional impact (anxiety) associated with the idea of undergoing the test. *"I began to see genetic testing as an opportunity to do prevention rather than the risk of living badly the news of a possible positivity to the test.[...]and so that stuff there on the one hand calms me down a little bit because I know I have some tools that I could use to better deal with what might happen.."* (ID7).
  - **Perceived benefit of prevention.** Often participants who believed that prevention would result in improved outcomes for themselves and more

effective care had a positive attitude towards genetic testing. *"But I am convinced of the fact that information is always an extra weapon that one can have in short.. if I know maybe I can do prevention, but this at the moment is what is in my imagination"* (ID2).

- **Avoidance of regret**. Men often described the desire to feel that they had done all they could as a motivator to undergo the test, to avoid having the regret of not having done something that could have been done. One participant reported *"Compared to catching the tumor in 5-10 years and finding out that it is too late... then I could say to myself "I could have done something earlier, I could have done the test when I had the conversation with the doctor advising me."* (ID2).

- Interpersonal Level
  - **Engagement in caregiving- involvement in the carrier's cancer journey.** Being directly involved in the treatment process (e.g., accompanying the affected carrier to medical appointments) and being in direct contact with the carrier's disease has been reported to be a factor that makes one emotionally and cognitively involved concerning the issue of undergoing genetic testing. One participant said: *"I think that guys of my age who haven't had my experience like I had with my mother, they would never go and do something like that...I mean they don't even know maybe what genetic mutation is! I certainly by bad luck ended up with it.."* (ID2).
  - **Carrier communication about genetic testing relevance.** In a family in which there were good communication levels and in which the carrier emphasized the relevance of genetic testing, health-preventive behaviors have been observed by family members (e.g., seeking more information about genetic testing, taking generic blood tests). *"My sister said to me "Look, unfortunately, all we're in the middle of this issue. So maybe you too, although in a smaller percentage, and it would be better for you to undergo genetic testing." Probably, actually definitely, it was that year that I did that blood analysis (CA125) to make sure that there wasn't something out of control in me"* (ID9).
- Providers Level
  - **Actionability of results**. Participants described the presence of

preventive interventions or other available actions with the potential to change the clinical course of the disease/condition, leading to an improved health outcome, as an important factor in promoting intention to uptake genetic testing. One reported *"In short it turned out that my mom had this mutation, and then it was possible to put her inside this protocol reducing her future cancer risk. It is important if then you can do something with the results.."* (ID2).

- **Provider recommendation**. Many participants emphasized the significance of receiving a direct recommendation from healthcare providers regarding the importance of undergoing genetic testing. Likewise, information provided by physicians or healthcare personnel was deemed crucial in the decision-making process. It is worth mentioning that for some participants, being invited to participate in this study was already viewed as direct contact from a healthcare provider, although it should be clarified that the contact was made by researchers, not genetic test providers. One participant said *"No never, I've tried to stay away from it (laughs) ... until now (laughs)... because in the last period I've come back to thinking about the possibility to undergo genetic testing... especially after your email, I mean it is like the topic becomes relevant again here (laughs)... because I'm being contacted by you, I'm investing "time" again.."* (ID1). Another one reported *"Anyway if someone told me "You have to do it, it is important that you do it" I would do it, just tell me where and when and I would show up.."* (ID8).

Self-Efficacy

Participants with high levels of self-efficacy tend to imagine success and anticipate potential positive outcomes. Few promoting factors seem to affect

- Individual Level
    - **Previous experience with hospitals and examinations.** Participants with previous personal experience with hospitals, exams, or check-ups reported a positive attitude towards undergoing genetic testing; *"I've always been in the hospital, I've been operated on so many times; so there's nothing that scares me, I wouldn't be afraid to take the test"* (ID1).

Others

- Individual Level
    - **Perceived "right time".** Some participants appeared to be waiting for what they perceived as the most suitable moment to undergo genetic testing. This sense of the "right time" was often associated with specific personal life events or conditions, such as achieving a stable working situation or the birth of a child. A participant described *"Now I have been stabilized for a couple of years, I went back to Italy then I stabilized with work, and now I have a little bit more open mind to be able to have certain issues dealt with.."* (ID2).
    - **Search for information**. Some participants mentioned that they actively sought out and utilized information from external sources, including websites or personal contacts, to gather more information and assess their options before deciding on undergoing genetic testing. One reported *"When my sister told me about the mutation, I decided to ask for information in the hospital where I was working. I wanted to know more about it, and I would have wanted to undergo the test"* (ID5).
- Interpersonal Level
    - **Social support.** Participants emphasized the importance of seeking social support from family members of the same gender (other brothers) or other family members (sisters, wife). The opinions and choices of these significant others were seen as reinforcing and increasing their motivation to undergo genetic testing. One participant reported *"Yes, even talking about it with my brother.. because he is also in the same situation as me ... he hasn't been tested yet! So, we discussed the theme! And my wife would like me to undergo the test"* (ID7).
    - **Health status of the carrier**. The belief that the affected carrier was no longer at risk and the improvement of her health condition was noted as promoting factors for genetic testing. *"Because in the last period, I've come back to thinking about genetic testing…[...]maybe also a little bit because I feel I'm a little less afraid... because of how my sister's health status is evolving, she is healthy now... maybe let's say I'm lowering the fear barrier a little bit... maybe!"* (ID10).
    - **Family cohesion**. Some participants described family cohesion as an

important component that motivated them to pursue genetic testing, *"that is in the sense that we were like three satellites, basically one pointed at the other.. so everything was transmitted instantly.. so we never had much difficulty communicating!"* (ID2).

- Provider Level
    - **Clear information about the logistics of genetic testing.** Participants emphasized the importance of support from healthcare providers in terms of providing clear information about where to undergo genetic testing, the procedure itself, associated costs, and other practical details. This information was considered essential to support their decision to undergo genetic testing. "*Well, I'd like to know how the test is done...and then where I could do it, should I ask the attending physician or which hospital to do it in, I don't have a clue...I'd like to understand basically how I should go about it."* (ID10).

Table 4. Promoting factors to CS uptake for male FDRs

Theme	Level	Subthemes	Exemplar quotations
Risk Perception	*Individual level*	Stage of life	..also because I'm going into my fifties...and in general I would have done medical checkups. I would have done a general check...so I'm also opting to do this genetic test (ID10)
		Personal history of risk factors/disease	I've had some very small problems that are under control, related to stress, maybe previous smoking, a lot of aspects and I had an episode of mild hypertension.. that led me to manage my healthy and good habits because for a while I tried both to stop smoking, to do sports.. this situation has led me to adjust my focus a little bit and then certainly to accept this interview and possibly evaluate genetic testing (ID9)
	Interpersonal level	Concern for the health of other family members	but when it, unfortunately, touches you because you have sisters and father who have had cancer, it is clear then that it interests you a little more ... that's why I am worried about my children, not about me... at first, I told you that I was not worried about me, but about my children.. (ID4)
		Communication with the carrier about male risk	... I remember that she told me that it was important to do it, because we were all, including men, being basically an at-risk family... (ID3)
		Carrier's death	..in the last period, after mom's death, surely what happened led me a little bit more to ask myself questions, to see if I can investigate a little bit, not in an exaggerated urgency because you know sometimes life should also be lived a little bit lightly in my opinion. (ID2)
	Provider level	/	/
	Environmental level	/	/
Positive Outcome Expectancies	*Individual level*	Trust in medicine/research	..I have always had enough faith in medicine, even in recent events. I mean for better or worse, if you don't trust doctors who should you trust basically? (ID6)

	Knowledge about the link between genetic testing and prevention	..there is a possibility to understand if you are actually predisposed to certain cancers… so maybe intervene with prevention and control! (ID7)
	Perceived benefit of prevention	..but I am convinced of the fact that information is always an extra weapon that one can have in short. if I know maybe I can do prevention (ID2)
	Avoidance of regret	Compared to catching the tumor in 5-10 years and finding out that it is too late... then I could say to myself "I could have done something earlier, I could have done the test when I had the conversation with the doctor advising me..." (ID2)
Interpersonal level	Engagement in caregiving-involvement in the cancer journey	I think that guys of my age who haven't had my experience like I had with my mother, would never go and do something like that...I mean they don't even know maybe what genetic mutation is! I certainly by bad luck ended up with it ..(ID2)
	Carrier communication about genetic testing relevance	She talked to me about it with a protective attitude... in the sense of "Look, I did this test, it turned out to be this genetic mutation, it means it is a hereditary thing, it is something that's within our genes... so it would be for you, for your good.. it would be helpful for you to do it, for you to know if you have this type of mutation, to do prevention" (ID7)
Provider level	Actionability of results	Well, let's say that anyway having the knowledge that you are at risk, if you then still have interventions that lead you to reduce what are future problems, is definitely a huge advantage (ID6)
	Provider recommendation	..in general, the fact that you contacted me about this study was a fairly decisive thing for me. I talked with my brother about the fact that we had both received the proposal to participate in this study.. probably if I hadn't received the email, it is a decision that I wouldn't have faced right now, that of undergoing the test... that is, while confirming the decision-making process we talked about, probably it is a decision that I would have made later. I would have waited for some other signal..(ID6)

	Environmental level	/	
Self-Efficacy	*Individual level*	Previous experience with hospitals and examinations	I've always been in the hospital, I've been operated on so many times... so there's nothing that scares me, I wouldn't be afraid to take the test. (ID1)
	Interpersonal level	/	/
	Provider level	/	/
	Environmental level	/	/
Others	*Individual level*	Perceived “right time”	If I have to tell you the truth, the birth of my daughter is making me change my perspective, because obviously now with the family that has expanded, with my daughter the reasoning that I'm doing is a little bit different...that is, maybe it is better to extend my life expectancy as much as possible, to try to stay healthy as much as possible. (ID11)
		Search for information	Bah, it is Brad Pitt's wife, Angelina Jolie.... this story came up right after my sister had done exams and surgery... so it amplified a little bit my motivation to go deeper into the information..(ID9)
	Interpersonal level	Social support	then this stuff comes up. I think I talked to my brother some time ago, I told him that precisely I was a little bit conflicted, I didn't know whether to undergo this test or not, but we didn't talk about it very much..[...] I've talked about it obviously with my wife, with my best friend. ..but with nobody of a medical professional (ID11)
		Health status of the carrier	because in the last period, I've come back to thinking about genetic testing…[...]maybe also a little bit because I feel I'm a little less afraid... because of how my sister's health status is evolving...she is healthy now.. maybe let's say I'm lowering the fear barrier a little bit... (ID10)
		Family cohesion	that is in the sense that we were like three satellites, basically one pointed at the other ... so everything was transmitted instantly... so we never had much difficulty communicating (ID2)

	Provider level	Clear information about the logistics of genetic testing	But of course, I would like to know what the test is, how it works, when I have to do it, what it entails, if I have to do it, if I have to do any treatment before. some more clarity would help me further, but in my heart, I think I have already made my decision, yes. (ID11)
	Environmental level	/	/

4.4 Discussion

The implementation of genetic testing in at-risk male relatives of BRCA1/2 PV carriers is a multifaceted process that involves various stakeholders, including individuals, carriers, healthcare providers, as well as the broader environment. The purpose of using qualitative methods in this study was to gain a deeper insight into the obstacles hindering and the factors promoting men's adherence to CS for BRCA1/2 PVs.

In this study, several factors at the individual and interpersonal as well as provider levels, and a few factors at the environmental level, have been described as barriers and promoting factors to CS for HBOC. Consistent with the findings from our quantitative data (Ongaro, Petrocchi, et al., 2022), our results illustrated how various barriers and facilitators influence the constructs of risk perception and outcome expectations. Additionally, it is noteworthy that the construct of self-efficacy appeared to have a less pronounced role in this process. Our research identified additional factors beyond those incorporated in the HAPA model that have a notable impact on CS uptake, suggesting that a comprehensive understanding of the factors influencing CS adherence may require the incorporation of broader elements and perspectives beyond those addressed by the theoretical model.

Our findings indicated a noticeable issue in the limited awareness and prevalence of inaccurate knowledge, which adversely influences participants' perceptions regarding the severity of health threats and their own susceptibility to them. Men's perception of the severity of health threats linked to BRCA1/2 PVs and their sense of personal vulnerability played pivotal roles in shaping their attitudes toward genetic testing. Our results supported the idea that understanding the gravity of these threats and recognizing their susceptibility could significantly influence their decision-making regarding testing.

Inaccurate knowledge among men regarding BRCA1/2 genetic testing was particularly prevalent in three key areas:

- Inheritance pattern: many men lacked a clear understanding of the inheritance pattern of BRCA1/2 PVs. This knowledge gap hindered their ability to comprehend the familial risk and the importance of CS;
- Testing procedure: some men perceived BRCA1/2 genetic testing as an invasive or uncomfortable procedure due to misinformation. Such misconceptions may deter them from pursuing testing, even though it often involved a blood sample or saliva collection (Kaczor-Urbanowicz et al., 2019);
- BRCA1/2 PVs implications for men: men often underestimated the relevance of BRCA1/2 PVs for their own health. They may not have been aware of the potential health implications, including an increased risk of certain cancers, and could erroneously believe that BRCA testing was primarily a concern for women.

Addressing these inaccurate beliefs and providing accurate, easily understandable information in these areas can be crucial to facilitating informed decision-making and increasing men's engagement in CS (Peshkin et al., 2021). Moreover, the perception of being in good health served as a substantial barrier, leading some to view genetic testing as irrelevant to their well-being. Interestingly, men expressed heightened concerns about cancers that afflicted male members of their family, reinforcing the idea that gender played a pivotal role in molding one's perception of health and illness (Peshkin et al., 2021; Shiloh et al., 2013). This highlighted the imperative need to customize communication strategies and interventions based on the gender of the relatives and their health status.

Evidence from this study suggested that one of the primary obstacles to CS for men revolved around concerns regarding potential psychological consequences following genetic testing and apprehensions about having to undergo excessive screening once they received GRI. Existing literature indicated that the uncertain nature of GRI can deter individuals from pursuing genetic testing, as they grappled with the potential psychological implications of such information (P. Daly et al., 2003; Strømsvik et al., 2011). Furthermore, as substantiated by the quantitative study presented earlier (Ongaro, Petrocchi, et al., 2022), the absence of a commonly acknowledged perceived benefit linked to genetic testing remained a significant impediment to the uptake of CS. In particular, men's limited knowledge about how to effectively manage their elevated risk and their perception of screening behavior as a deficient control strategy contribute to

this barrier. On the contrary, vital was men's belief in the actionability and effectiveness of health measures that can follow genetic testing. Understanding the potential benefits of early detection and risk reduction strategies can motivate men to get tested.

At an interpersonal level, our results suggested that several factors can influence men's decisions regarding CS. Specifically, effective communication within the family was crucial. The lack of conversations and limited communication with female carriers or low involvement in discussions about cancer and genetic testing within the family can contribute to a lack of awareness and motivation for CS. In some cultures, discussing genetic testing or cancer risk may be stigmatized or not commonly practiced by family members (Rauscher et al., 2018; Strømsvik et al., 2010). Contrastingly, our research has revealed that open discussions between carriers and their male relatives about the importance of undergoing testing, and about male implications in BRCA1/2 PVs can serve as a promoting factor for CS, highlighting the value of social support and dialogue in the decision-making process regarding CS. Additionally, the literature showed that when family members were directly impacted by cancer, relatives may encounter heightened fear and anxiety related to the cancer experience (Strømsvik et al., 2011). Our results indicated that these emotional responses can potentially deter them from considering genetic testing. Conversely, factors such as the health status of the carrier and the temporal distance from the cancer diagnosis can act as promoters of adherence to CS. It is intriguing to note that among the participants, only one reported being motivated to undergo genetic testing with the primary goal of protecting their family. This stands in contrast to existing literature that often portrays men's decisions as driven by a sense of familial duty or obligation, particularly toward their children (Hallowell et al., 2005; Hesse-Biber & An, 2017; Rauscher et al., 2018; Shiloh et al., 2013). This discrepancy highlighted the diverse and individualized motivations that men may have when considering genetic testing, supporting the idea that men in a pre-intentional phase may place greater emphasis on the general benefits of testing without fully grasping the broader familial implications.

Additionally, our findings indicated that the role of the provider is critical in CS, and healthcare providers could wield significant influence over men's choices regarding CS, directly impacting their perception of risk and their outcome expectancies. The absence of a direct recommendation for testing and communication with family members contributed to creating a false sense of reassurance for many men. It may lead them to believe that they were not involved in the matter and were not exposed to any

cancer risk. On the contrary, a direct recommendation from a trusted healthcare professional can encourage men to consider genetic testing (Henrikson et al., 2021). This finding aligns with the results of another study that investigated non-directive counseling approaches in families with BRCA1/2 variants (Sermijn et al., 2004). The study suggested that, especially in cases of hereditary cancers, more directive approaches may be necessary, even when direct provider contact with relatives was not feasible. This underscored the importance of adapting counseling strategies to the specific context, needs, and preferences of individuals and families dealing with hereditary cancer risks.

Moreover, the findings of this study indicated that one environmental factor, such as the accessibility to healthcare services, including genetic counseling and testing, exerted a substantial influence on men's decisions regarding CS. In areas where healthcare services are easily accessible and affordable, men may be more inclined to CS uptake, underscoring the pivotal role of healthcare infrastructure and affordability in promoting preventive healthcare behaviors.

It is indeed intriguing to observe that factors not included in the theoretical model (HAPA) emerged as significant influences in the decision-making process related to CS. For example, men often displayed low levels of self-care and exhibited reluctance in seeking medical check-ups. Additionally, they frequently reported that competing life concerns served as deterrents to their consideration of genetic testing while they expressed a desire to find the "right time" for contemplating genetic testing. These findings underscored the complexity of decision-making in this context and suggested that men weigh various personal, practical, and temporal factors when making these decisions. Recognizing these additional factors is essential for crafting comprehensive and effective strategies to engage men in genetic testing discussions and ultimately promote adherence to CS recommendations.

Remarkably, it is worth noting that following their participation in this research study, a notable portion of the participants, specifically seven out of eleven (approximately 63%), expressed a desire to undergo BRCA1/2 genetic testing. Six of these participants were placed on a waiting list, with an expected waiting period of around one year, at the Division of Cancer Prevention and Genetics of the IEO. Meanwhile, one participant was directed to a facility within his residential area and subsequently underwent genetic testing, with the outcome revealing the absence of BRCA1/2 PVs.

Interestingly, several participants referred to their involvement in the research study and the profound discussions regarding the decision to pursue genetic testing as a pivotal "signal". This signal, in their view, served as a catalyst for their determination to proceed with testing. It is worth noting that, in some instances, participants appeared to conflate the roles of researchers and healthcare providers, perceiving them as somewhat overlapping. Nevertheless, these encouraging results underscored the potential significance of direct involvement and contact by healthcare providers with men in the context of CS. Such engagement can foster a sense of inclusion and active participation in the screening process, ultimately bolstering men's adherence to CS initiatives.

Limitations

Some limitations of the current study should be noted. Firstly, it is crucial to recognize that all participants in the study were exclusively White males from a single country, Italy. This homogeneity in the sample composition may restrict the generalizability of the study's findings. Future research endeavors could undertake a comparative approach, examining barriers and promoting factors by including samples from diverse geographical locations and encompassing various racial and ethnic backgrounds. Moreover, as observed in the quantitative study presented in Chapter 3, it is plausible that the probands and consequently, the FDRs who willingly participated in the interviews were those who already possessed a higher level of engagement and interest in exploring the possibility of undergoing genetic testing. This self-selection bias may have potentially inflated certain conclusions. It is conceivable that individuals who were more averse to the notion of genetic testing may have declined participation, thereby introducing a bias toward more positive views. Another noteworthy limitation lies in the fact that, in this study, potential promoting factors and facilitators can only be inferred and hypothesized based on participants' responses. To gain deeper insights into these factors, future investigations should consider comparing the experiences and perspectives of untested individuals with those who have already undergone genetic testing. This comparative approach would enable a more precise identification of effective strategies for promoting adherence to CS initiatives.

Chapter 5. General Discussion and Conclusions

CS for HBOC holds significant importance as a public health priority. The findings of this study underscore the importance of considering men's motivations for genetic testing in the context of HBOC syndrome. These insights challenge previous research results and suggest that a nuanced approach is needed when understanding men's decision-making processes. It appears that, for men who have not yet undergone genetic testing, family considerations play a limited role. Instead, their primary focus is on gaining a comprehensive understanding of the broader benefits associated with genetic screening and how it might impact their overall health. These conclusions are supported by both quantitative and qualitative data, opening up avenues for further research in this area.

On a theoretical level, our research findings offered partial support for the Health Action Process Approach as a valuable framework upon which to base interventions within the context of CS for BRCA1/2 PVs. Specifically, it appeared that the most influential factor shaping the intention to adhere to genetic testing guidelines for relatives of BRCA1/2 carriers was the perceived benefit of undergoing genetic testing. Subsequently, the planning of action was a result of both the intention itself and the individual's perceived self-efficacy in coping with interfering obstacles. These observations in both qualitative and quantitative data reinforced the significance of risk perception and outcome expectations in shaping individuals' decisions and behaviors, while also suggesting that self-efficacy may be a less influential factor in the context of CS. Furthermore, when considered collectively, our findings indicated that men were lacking in their level of knowledge about BRCA1/2 PVs, and implications for men, and presented several inaccurate beliefs and outcome expectations that were barriers to CS adherence. However, often men showed some motivation and intentionality toward undergoing genetic testing, which must be adequately supported with clear information and practical assistance in planning to sustain the enactment of the behavior. It is plausible to anticipate more favorable outcomes in terms of promoting men's adherence to CS by implementing a volitional treatment approach. This is because planning and coping self-efficacy are closer in proximity to behavior and are likely to be instrumental in facilitating the initiation and planning of the screening behavior. By focusing on these volitional

aspects, interventions and strategies can be better tailored to support men in taking concrete steps toward participating in CS. It is imperative to provide robust support for men in their screening planning process. This entails furnishing them with explicit details regarding genetic testing procedures, available testing locations, associated costs, and most crucially, comprehensible insights into the implications of their test results in terms of possible screening behaviors or strategies that can be undertaken to control the risk.

Moreover, research findings regarding the high screening adherence rates following involvement in the qualitative study are noteworthy. This observation underscores the potential impact of engaging individuals in discussions about their decision-making process regarding CS. Probably, the opportunity for participants to openly discuss and explore their thoughts, concerns, and motivations regarding screening may have been instrumental in clarifying their decision-making process. This discussion may have provided them with a better understanding of the benefits of screening. Furthermore, the fact that participants were contacted as part of the qualitative study, especially without the involvement of a carrier facilitator, suggests that direct engagement can be a powerful motivator. It implies that active outreach and contact with individuals can promote their involvement in healthcare decisions. While the observation is promising, it is essential to acknowledge the limitations and context-specific factors that may have contributed to the high adherence rates. Future research can help validate and expand upon these findings and could explore the generalizability of this finding across different populations and settings.

Certainly, despite the limitations that have been detailed for each study, this mixed-method research project boasts several significant strengths. Firstly, the utilization of a mixed-method design allows for a holistic examination of the CS context for men. By incorporating both qualitative and quantitative data, the study provides a well-rounded understanding of the various factors at play in men's decision-making process. Notably, it diverges from previous research that has examined a broader range of relatives, extending from first- to third-degree connections. Instead, our study deliberately concentrated on a homogeneous sample comprising solely first-degree relatives. This focus ensured that all participants shared an equivalent 50% risk of either inheriting or transmitting the PV in question. Furthermore, it is important to underscore that our sample exclusively comprised individuals who had not undergone genetic counseling sessions in the past. Consequently, their knowledge and attitudes remained untainted by any prior

exposure to information that typically forms the foundation for making informed decisions concerning BRCA1/2 genetic testing, as highlighted by Oliveri and colleagues (Oliveri, Masiero, et al., 2016). This strategic approach is a unique and valuable aspect of the study and it ensures that the research captures the experiences and perspectives of a specific and often underrepresented group. Furthermore, in this study, we made a deliberate choice to employ the absence of cancer pathology as an exclusion criterion. By focusing exclusively on healthy participants, our objective was to investigate the barriers and promoting factors to CS, psychological factors, and message effectiveness in a sample of individuals who were not explicitly directed toward genetic testing based on their personal disease history. To our knowledge, previous studies have not typically provided information regarding the health status of the participants. However, it is worth noting that personal experiences with disease, particularly cancer, can significantly influence one's attitudes, interest in genetic risk information, and receptiveness to recommendations in this regard. These experiences may introduce variations in the decision-making process and should be considered in future research endeavors. Moreover, the study's identification of factors not initially included in the theoretical model provides valuable contributions to the field and highlights the complexity of CS decision-making.

Future Research

Based on the results of our study, there are several promising directions for future research. Firstly, future studies could explore the effectiveness of two different approaches to engaging men in CS (patient-mediated and provider-facilitated approaches) comparing the outcomes, adherence rates, and satisfaction levels of these two approaches to determine which is more effective in engaging men in the CS process. In addition, future studies could examine the effectiveness of familial messages, taking into consideration the impact of such messages on the population with children. Specifically, it might be interesting to assess the effect, considering the gender of the children, whether they are male or female, given the misconception about the impact of genetic mutation only on the female gender. The RCT did not include a condition with both messages evaluated together. This was, of course, not possible given the study aims and the difficulty in recruiting a sufficient number of participants but may be tested in a future study, for example, comparing a combined message against none (i.e., only basic information). Furthermore, future studies might focus on evaluating the impact of online-

accessible informational materials specifically tailored for men in the context of promoting CS. These materials should comprehensively address the implications of genetic testing for men, including the potential benefits in terms of preventive strategies and screening procedures. Future studies could focus their efforts on exploring innovative communication strategies that resonate with men and encourage their active participation in CS. The use of multimedia, digital platforms, and social media to effectively reach and engage this demographic group could be considered. Longitudinal studies could track the long-term effects of cascade screening on men's health outcomes. This could include assessing changes in screening behaviors, risk reduction strategies, and overall health status over an extended period. Educational programs for patients and their families that emphasize the importance and relevance of CS could be developed, highlighting the potential benefits of early detection and prevention for both affected and at-risk family members. In the end, conducting health economics analyses to evaluate the cost-effectiveness of CS programs targeted at men is a valuable direction for future research. Future studies can provide valuable insights into the financial implications of CS programs for men, demonstrating their potential to save healthcare costs through early detection and prevention of hereditary cancers. These research directions can contribute to a more comprehensive understanding of how to engage men effectively in cascade screening and improve their awareness, motivation, and adherence to this critical preventive healthcare measure.

Conclusions

In conclusion, our mixed-method study delved into factors influencing men's adherence to CS. Our findings shed light on several key observations:

- Knowledge Gaps and Inaccurate Beliefs: men exhibited a notable lack of knowledge regarding BRCA1/2 PVs and their implications for men's health. Additionally, many held inaccurate beliefs and misconceptions, which acted as barriers to their CS adherence.
- Motivation and Intent: Encouragingly, we observed that men displayed motivation and intentionality regarding genetic testing. However, this motivation needs to be effectively harnessed and sustained.

Given these insights, it is paramount to provide comprehensive support to men throughout their screening planning process. This support should encompass the following aspects:

- Clear Information: Men should be provided with clear and accurate information

about the genetic testing procedure, including its purpose, potential benefits, and the implications of the results;

- Practical Assistance: Practical assistance is essential in planning the testing process, including guidance on available testing locations and associated costs.
- Insights into Implications: Crucially, men must receive understandable insights into the implications of their test results. This includes guidance on possible screening behaviors and strategies that can be adopted to manage their risk effectively.

By addressing these vital components, we can empower men to make informed decisions about CS and enhance their adherence to this crucial preventive measure.

Our findings suggested several potential directions for future promoting interventions in at-risk male relatives setting. Specifically, developing educational materials and resources that specifically target men and address their concerns could improve CS uptake. Although our finding warrants exploration in further studies, the focus should be on improving awareness that the HBOC autosomal dominant PV is not sex-specific. Thus, gender-specific education materials, particularly education aimed at male family members, may be helpful. Continued education and public awareness regarding male involvement in HBOC syndrome, their cancer risk, and surveillance strategies for men can be critical. A well-crafted communication strategy can have the potential to help men overcome their fear of stigmatization and encourage them to seek health information. In light of these considerations, there is a pressing requirement to enhance the accessibility of information regarding BRCA1/2 testing for men and to devise efficacious alternatives to the traditional patient-mediated setting methods, exploring other delivery methods such as provider-facilitated methods, where trained providers directly contact at-risk relatives of the carriers (Peshkin et al., 2021; Srinivasan et al., 2020). Furthermore, these outcomes underscore the importance of implementing integrated genetic counseling sessions that foster close collaboration between geneticists and psychologists. Moreover, interventions should be designed to enhance men's self-monitoring skills, thereby bolstering their coping self-efficacy.

A comprehensive understanding of what influences men’s adherence to CS holds significant potential, helping in targeting effective promotion strategies, as well as promoting primary disease prevention in not affected by cancer men, reducing morbidity and mortality associated with HBOC syndrome. In summary, the collective findings from this research study add impetus to the research and interventions in the context of men’s health.

References

Ainiwaer, A., Zhang, S., Ainiwaer, X., & Ma, F. (2021). Effects of Message Framing on Cancer Prevention and Detection Behaviors, Intentions, and Attitudes: Systematic Review and Meta-analysis. *Journal of Medical Internet Research*, *23*(9), e27634. https://doi.org/10.2196/27634

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Alleati per la Salute. (2023). *Cancro al seno, in Lombardia estensione del ticket anche agli uomini*. https://www.alleatiperlasalute.it/cancro-al-seno-lombardia-estensione-del-ticket-anche-agli-uomini

American College of Obstetricians and Gynecologists. (2018). Cascade testing: testing women for known hereditary genetic mutations associated with cancer. *ACOG Committee Opinion No. 727*, *131*(1), 4.

Andrews, L., Meiser, B., Apicella, C., & Tucker, K. (2004). Psychological Impact of Genetic Testing for Breast Cancer Susceptibility in Women of Ashkenazi Jewish Background: A Prospective Study. *Genetic Testing*, *8*(3), 240–247. https://doi.org/10.1089/GTE.2004.8.240

Annoni, A. M., & Longhini, C. (2022). Investigating men's motivations to engage in genetic screening for BRCA1 and BRCA2 mutations. *PloS One*, *17*(3), e0265387. https://doi.org/10.1371/JOURNAL.PONE.0265387

Arbour-Nicitopoulos, K. P., Duncan, M., Remington, G., Cairney, J., & Faulkner, G. E. (2014). Development and reliability testing of a health action process approach inventory for physical activity participation among individuals with schizophrenia. *Frontiers in Psychiatry*, *5*(JUN), 93463. https://doi.org/10.3389/FPSYT.2014.00068/ABSTRACT

Arver, B., Haegermark, A., Platten, U., Lindblom, A., & Brandberg, Y. (2004). Evaluation of psychosocial effects of pre-symptomatic testing for breast/ovarian and colon cancer pre-disposing genes: A 12-month follow-up. *Familial Cancer*, *3*(2), 109–116. https://doi.org/10.1023/B:FAME.0000039863.89137.F9

Ayme, A., Viassolo, V., Rapiti, E., Fioretta, G., Schubert, H., Bouchardy, C., Chappuis, P. O., & Benhamou, S. (2014). Determinants of genetic counseling uptake and its impact on breast cancer outcome: a population-based study. *Breast Cancer Research*

and Treatment, *144*(2), 379–389. https://doi.org/10.1007/S10549-014-2864-3

Azorín, J., & Cameron, R. (2010). The application of mixed methods in organisational research: A literature review. *Electronic Journal of Business Research Methods*, *8*, 95–105.

Bandura, A. (1997). Self-efficacy: The exercise of control. In *Self-efficacy: The exercise of control.* W H Freeman/Times Books/ Henry Holt & Co.

Barg, C. J., Latimer, A. E., Pomery, E. A., Rivers, S. E., Rench, T. A., Prapavessis, H., & Salovey, P. (2012). Examining predictors of physical activity among inactive middle-aged women: An application of the health action process approach. *Psychology and Health*, *27*(7), 829–845. https://doi.org/10.1080/08870446.2011.609595

Bednar, E. M., Sun, C. C., McCurdy, S., & Vernon, S. W. (2020). Assessing relatives' readiness for hereditary cancer cascade genetic testing. *Genetics in Medicine*, *22*(4), 719–726. https://doi.org/10.1038/s41436-019-0735-3

Bjorvatn, C., Eide, G. E., Hanestad, B. R., Øyen, N., Havik, O. E., Carlsson, A., & Berglund, G. (2007). Risk perception, worry and satisfaction related to genetic counseling for hereditary cancer. *Journal of Genetic Counseling*, *16*(2), 211–222. https://doi.org/10.1007/S10897-006-9061-4

Bottesi, G., Ghisi, M., Novara, C., Bertocchi, J., e Ilaria, M. B., Dominicis, D., & Freeston, M. H. (2015). Intolerance of uncertainty scale (IUS-27 e IUS-12): Due studi preliminari. *Psicoterapia Cognitiva e Comportamentale*, *21*(3), 345–365.

Boyatzis, R. E. (1998). Transforming qualitative information: Thematic analysis and code development. In *Sage Publications, Inc.* Sage Publications, Inc.

Bradbury, A. R., Patrick-Miller, L., Pawlowski, K., Ibe, C. N., Cummings, S. A., Hlubocky, F., Olopade, O. I., & Daugherty, C. K. (2009). Learning of your parent's BRCA mutation during adolescence or early adulthood: a study of offspring experiences. *Psycho-Oncology*, *18*(2), 200–208. https://doi.org/10.1002/PON.1384

Braddock, K., & Dillard, J. P. (2016). Meta-analytic evidence for the persuasive effect of narratives on beliefs, attitudes, intentions, and behaviors. *Communication Monographs*, *83*(4), 446–467. https://doi.org/10.1080/03637751.2015.1128555

Brashers, D. E., Babrow, A., Goldsmith, D., Jackson, S., Jacobs, S., & Neidig, J. (2001). Communication and Uncertainty Management. *Journal of Communication*, *51*(3), 477–497. https://doi.org/10.1111/J.1460-2466.2001.TB02892.X

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative*

Research in Psychology, *3*(2), 77–101. https://doi.org/10.1191/1478088706QP063OA

Bray, F., Kohler, B., & Ferlay, J. (2014). Cancer Incidence in Five Continents Volume X. In D. Forman, F. Bray, D. H. Brewster, C. Gombe Mbalawa, B. Kohler, M. Piñeros, E. Steliarova-Foucher, R. Swaminathan, & J. Ferlay (Eds.), *Cancer Incidence in Five Continents Vol X.* International Agency for Research on Cancer.

Buchanan, A. H., Rahm, A. K., & Williams, J. L. (2016). Alternate service delivery models in cancer genetic counseling: A mini-review. *Frontiers in Oncology*, *6*(MAY), 185586. https://doi.org/10.3389/FONC.2016.00120/BIBTEX

Cacioppo, J. T., & Petty, R. E. (1979). Effects of message repetition and position on cognitive response, recall, and persuasion. *Journal of Personality and Social Psychology*, *37*(1), 97–109. https://doi.org/10.1037/0022-3514.37.1.97

Caiata-Zufferey, M., Pagani, O., Cina, V., Membrez, V., Taborelli, M., Unger, S., Murphy, A., Monnerat, C., & Chappuis, P. O. (2014). Challenges in managing genetic cancer risk: a long-term qualitative study of unaffected women carrying BRCA1/BRCA2 mutations. *Genetics in Medicine 2015 17:9*, *17*(9), 726–732. https://doi.org/10.1038/gim.2014.183

Carleton, R. N. (2016). Fear of the unknown: One fear to rule them all? In *Journal of Anxiety Disorders* (Vol. 41, pp. 5–21). Elsevier Ltd. https://doi.org/10.1016/j.janxdis.2016.03.011

Cherkas, L. F., Harris, J. M., Levinson, E., Spector, T. D., & Prainsack, B. (2010). A survey of UK public interest in internet-based personal genome testing. *PLoS ONE*, *5*(10). https://doi.org/10.1371/JOURNAL.PONE.0013473

Childers, K. K., Maggard-Gibbons, M., Macinko, J., & Childers, C. P. (2018). National Distribution of Cancer Genetic Testing in the United States: Evidence for a Gender Disparity in Hereditary Breast and Ovarian Cancer. *JAMA Oncology*, *4*(6), 876–879. https://doi.org/10.1001/JAMAONCOL.2018.0340

Chiu, C.-Y., Lynch, R. T., Chan, F., & Berven, N. L. (2011). The Health Action Process Approach as a motivational model for physical activity self-management for people with multiple sclerosis: A path analysis. In *Rehabilitation Psychology* (Vol. 56, Issue 3, pp. 171–181). American Psychological Association. https://doi.org/10.1037/a0024583

Claes, E., Evers-Kiebooms, G., Boogaerts, A., Decruyenaere, M., Denayer, L., & Legius, E. (2004). Diagnostic Genetic Testing for Hereditary Breast and Ovarian Cancer in

Cancer Patients: Women's Looking Back on the Pre-Test Period and a Psychological Evaluation. *Genetic Testing*, *8*(1), 13–21. https://doi.org/10.1089/109065704323015996

Corso, G., Feroce, I., Intra, M., Toesca, A., Magnoni, F., Sargenti, M., Naninato, P., Caldarella, P., Pagani, G., Vento, A., Veronesi, P., Bonanni, B., & Galimberti, V. (2018). BRCA1/2 germline missense mutations: A systematic review. *European Journal of Cancer Prevention*, *27*(3), 279–286. https://doi.org/10.1097/CEJ.0000000000000337

d'Agincourt-Canning, L., & Baird, P. (2006). Genetic testing for hereditary cancers: The impact of gender on interest, uptake and ethical considerations. *Critical Reviews in Oncology/Hematology*, *58*(2), 114–123. https://doi.org/10.1016/j.critrevonc.2006.03.001

da Silva, T. L. (2016). Male breast cancer: Medical and psychological management in comparison to female breast cancer. A review. *Cancer Treatment Communications*, *7*, 23–34. https://doi.org/10.1016/j.ctrc.2016.03.004

Daly, M. B., Pilarski, R., Yurgelun, M. B., Berry, M. P., Buys, S. S., Dickson, P., Domchek, S. M., Elkhanany, A., Friedman, S., Garber, J. E., Goggins, M., Hutton, M. L., Khan, S., Klein, C., Kohlmann, W., Kurian, A. W., Laronga, C., Litton, J. K., Mak, J. S., … Darlow, S. D. (2020). Genetic/familial high-risk assessment: Breast, ovarian, and pancreatic, version 1.2020 featured updates to the NCCN guidelines. *JNCCN Journal of the National Comprehensive Cancer Network*, *18*(4), 380–391. https://doi.org/10.6004/jnccn.2020.0017

Daly, M., Pal, T., Berry, M., Buys, S., Dickson, P., Domchek, S., Elkhanany, A., Friedman, S., Goggins, M., Hutton, M., Karlan, B., Khan, S., Klein, C., Kohlmann, W., Kurian, A., Laronga, C., Litton, J., Mak, J., Menendez, C., … Dwyer, M. (2021). Genetic/Familial High-Risk Assessment: Breast, Ovarian, and Pancreatic, Version 2.2021, NCCN Clinical Practice Guidelines in Oncology. *Journal of the National Comprehensive Cancer Network : JNCCN*, *19*(1), 77–102. https://doi.org/10.6004/JNCCN.2021.0001

Daly, Mary. (2009). The impact of social roles on the experience of men in BRCA1/2 families: Implications for counseling. *Journal of Genetic Counseling*, *18*(1), 42–48. https://doi.org/10.1007/s10897-008-9183-y

Daly, P., Nolan, C. C., Green, A., Ormiston, W., Cody, N., McDevitt, T., O'hIei, B., Byrne, D., McDermott, E., Carney, D. N., O'Higgins, N., & Barton, D. E. (2003).

Predictive testing for BRCA1 and 2 mutations: A male contribution. *Annals of Oncology*, *14*(4), 549–553. https://doi.org/10.1093/annonc/mdg164

Daniel, A. O., Omorogieva Enoma, I., & Omobude-Idiado, S. N. (2014). Application of Protection Motivation Theory (PMT) and Health Action Process Approach (HAPA) in promoting women's adaptive engagement towards breast self examination. *Academic Research International*, *5*(1), 291.

Di Pietro, M. L., Zaçe, D., Orfino, A., Di Raimo, F. R., Poscia, A., de Matteis, E., Turchetti, D., Godino, L., Bertonazzi, B., Franiuk, M., Bruzzone, C., Varesco, L., Lucci-Cordisco, E., & Genuardi, M. (2020). Intrafamilial communication of hereditary breast and ovarian cancer genetic information in Italian women: towards a personalised approach. *European Journal of Human Genetics 2020 29:2*, *29*(2), 250–261. https://doi.org/10.1038/s41431-020-00723-7

Dieteren, C. M., Brouwer, W. B. F., & Van Exel, J. (2020). How do combinations of unhealthy behaviors relate to attitudinal factors and subjective health among the adult population in the Netherlands? *BMC Public Health*. https://doi.org/10.1186/s12889-020-8429-y

Donovan, T., & Flynn, M. (2007). What makes a man a man? The lived experience of male breast cancer. *Cancer Nursing*, *30*(6), 464–470. https://doi.org/10.1097/01.NCC.0000300173.18584.37

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*. https://doi.org/10.3758/BF03193146

Finlay, E., Stopfer, J. E., Burlingame, E., Evans, K. G., Nathanson, K. L., Weber, B. L., Armstrong, K., Rebbeck, T. R., & Domchek, S. M. (2008). Factors Determining Dissemination of Results and Uptake of Genetic Testing in Families with Known BRCA1/2 Mutations. *Genetic Testing*, *12*(1), 81–91. https://doi.org/10.1089/GTE.2007.0037

Frank, T. S. (2001). Hereditary cancer syndromes. *Archives of Pathology & Laboratory Medicine*, *125*(1), 85–90. https://doi.org/10.5858/2001-125-0085-HCS

Frey, M. K., Ahsan, M. D., Bergeron, H., Lin, J., Li, X., Fowlkes, R. K., Narayan, P., Nitecki, R., Rauh-Hain, J. A., Moss, H. A., Baltich Nelson, B., Thomas, C., Christos, P. J., Hamilton, J. G., Chapman-Davis, E., Cantillo, E., Holcomb, K., Kurian, A. W., Lipkin, S., … Sharaf, R. N. (2022). Cascade Testing for Hereditary Cancer Syndromes: Should We Move Toward Direct Relative Contact? A Systematic

Review and Meta-Analysis. *Journal of Clinical Oncology*, *40*(35), 4129–4143. https://doi.org/10.1200/JCO.22.00303

Friedman, L. C., & Kramer, R. M. (2005). Reproductive issues for women with BRCA mutations. *Journal of the National Cancer Institute. Monographs*, *34*, 83–86. https://doi.org/10.1093/JNCIMONOGRAPHS/LGI012

Gallagher, K. M., & Updegraff, J. A. (2012). Health message framing effects on attitudes, intentions, and behavior: a meta-analytic review. *Annals of Behavioral Medicine : A Publication of the Society of Behavioral Medicine*, *43*(1), 101–116. https://doi.org/10.1007/S12160-011-9308-7

Garutti, M., Foffano, L., Mazzeo, R., Michelotti, A., Da Ros, L., Viel, A., Miolo, G., Zambelli, A., & Puglisi, F. (2023). Hereditary Cancer Syndromes: A Comprehensive Review with a Visual Tool. *Genes*, *14*(5), 1025. https://doi.org/10.3390/GENES14051025/S1

Giri, V. N., Knudsen, K. E., Kelly, W. K., Cheng, H. H., Cooney, K. A., Cookson, M. S., Dahut, W., Weissman, S., Soule, H. R., Petrylak, D. P., Dicker, A. P., AlDubayan, S. H., Toland, A. E., Pritchard, C. C., Pettaway, C. A., Daly, M. B., Mohler, J. L., Parsons, J. K., Carroll, P. R., … Gomella, L. G. (2020). Implementation of Germline Testing for Prostate Cancer: Philadelphia Prostate Cancer Consensus Conference 2019. *Journal of Clinical Oncology : Official Journal of the American Society of Clinical Oncology*, *38*(24), 2798–2811. https://doi.org/10.1200/JCO.20.00046

Graves, K. D., Gatammah, R., Peshkin, B. N., Krieger, A., Gell, C., Valdimarsdottir, H. B., & Schwartz, M. D. (2011). BRCA1/2 genetic testing uptake and psychosocial outcomes in men. *Familial Cancer*, *10*(2), 213–223. https://doi.org/10.1007/s10689-011-9425-2

Gray, J. B., & Harrington, N. G. (2011). Narrative and framing: A test of an integrated message strategy in the exercise context. *Journal of Health Communication*, *16*(3), 264–281. https://doi.org/10.1080/10810730.2010.529490

Griffin, N. E., Buchanan, T. R., Smith, S. H., Leon, A. A., Meyer, M. F., Liu, J., Tabak, R. G., Fuh, K. C., Thaker, P. H., Powell, M. A., Mutch, D. G., Massad, L. S., Colditz, G. A., & Hagemann, A. R. (2020). Low rates of cascade genetic testing among families with hereditary gynecologic cancer: An opportunity to improve cancer prevention. *Gynecologic Oncology*, *156*(1), 140–146. https://doi.org/10.1016/J.YGYNO.2019.11.005

Hallowell, N., Ardern-Jones, A., Eeles, R., Foster, C., Lucassen, A., Moynihan, C., &

Watson, M. (2005). Men's Decision-Making About Predictive BRCA1/2 Testing: The Role of Family. *Journal of Genetic Counseling*, *14*(3), 207–217. https://doi.org/10.1007/s10897-005-0384-3

Hamilton, J. G., Lobel, M., & Moyer, A. (2009). Emotional Distress Following Genetic Testing for Hereditary Breast and Ovarian Cancer: A Meta-Analytic Review. *Health Psychology*, *28*(4), 510. https://doi.org/10.1037/a0014778

Hampel, H. (2016). Genetic counseling and cascade genetic testing in Lynch syndrome. *Familial Cancer*, *15*(3), 423–427. https://doi.org/10.1007/S10689-016-9893-5

Hannah, D. R., & Lautsch, B. A. (2010). Counting in Qualitative Research: Why to Conduct it, When to Avoid it, and When to Closet it. *Journal of Management Inquiry*, *20*(1), 14–22. https://doi.org/10.1177/1056492610375988

Hattar, A., Pal, S., & Hagger, M. S. (2016). Predicting Physical Activity-Related Outcomes in Overweight and Obese Adults: A Health Action Process Approach. *Applied Psychology: Health and Well-Being*, *8*(1), 127–151. https://doi.org/10.1111/APHW.12065

Hayes, N. (1997). Theory-led thematic analysis: Social identification in small companies. In *Doing qualitative analysis in psychology.* (pp. 93–114). Psychology Press/Erlbaum (UK) Taylor & Francis.

Henneman, L., Vermeulen, E., Van El, C. G., Claassen, L., Timmermans, D. R. M., & Cornel, M. C. (2012). Public attitudes towards genetic testing revisited: comparing opinions between 2002 and 2010. *European Journal of Human Genetics 2013 21:8*, *21*(8), 793–799. https://doi.org/10.1038/ejhg.2012.271

Henrikson, N. B., Blasi, P., Gray, M. F., Tiffany, B. T., Scrol, A., Ralston, J. D., Fullerton, S. M., Lim, C. Y., Ewing, J., & Leppig, K. A. (2021). Patient and Family Preferences on Health System-Led Direct Contact for Cascade Screening. *Journal of Personalized Medicine*, *11*(6). https://doi.org/10.3390/JPM11060538

Hesse-Biber, S. (2018). Gender Differences in Psychosocial and Medical Outcomes Stemming From Testing Positive for the BRCA1/2 Genetic Mutation for Breast Cancer: An Explanatory Sequential Mixed Methods Study. *Journal of Mixed Methods Research*, *12*(3), 280–304. https://doi.org/10.1177/1558689816655257/ASSET/IMAGES/LARGE/10.1177_1558689816655257-FIG1.JPEG

Hesse-Biber, S., & An, C. (2016). Genetic Testing and Post-Testing Decision Making among BRCA-Positive Mutation Women: A Psychosocial Approach. *Journal of*

Genetic Counseling, *25*(5), 978–992. https://doi.org/10.1007/s10897-015-9929-2

Hesse-Biber, S., & An, C. (2017). Within-Gender Differences in Medical Decision Making Among Male Carriers of the BRCA Genetic Mutation for Hereditary Breast Cancer. *American Journal of Men's Health*, *11*(5), 1444–1459. https://doi.org/10.1177/1557988315610806

Hinyard, L. J., & Kreuter, M. W. (2007). Using narrative communication as a tool for health behavior change: A conceptual, theoretical, and empirical overview. *Health Education and Behavior*, *34*(5), 777–792. https://doi.org/10.1177/1090198106291963

Hong, S. J., Biesecker, B., Ivanovich, J., Goodman, M., & Kaphingst, K. A. (2019). Factors affecting breast cancer patients' need for genetic risk information: From information insufficiency to information need. *Journal of Genetic Counseling*, *28*(3), 543–557. https://doi.org/10.1002/JGC4.1087

Hopwood, P. (2000). Breast cancer risk perception: what do we know and understand? *Breast Cancer Research : BCR*, *2*(6), 387. https://doi.org/10.1186/BCR83

Huls, S. P. I., van Osch, S. M. C., Brouwer, W. B. F., van Exel, J., & Stiggelbout, A. M. (2020). Psychometric evaluation of the Health-Risk Attitude Scale (HRAS-13): assessing the reliability, dimensionality and validity in the general population and a patient population. *Psychology and Health*, *37*(1), 34–50. https://doi.org/10.1080/08870446.2020.1851689/SUPPL_FILE/GPSH_A_1851689_SM9967.DOCX

Isselhard, A., Lautz, Z., Rhiem, K., & Stock, S. (2023). Assessing Psychological Morbidity in Cancer-Unaffected BRCA1/2 Pathogenic Variant Carriers: A Systematic Review. *Current Oncology*, *30*(4), 3590–3608. https://doi.org/10.3390/CURRONCOL30040274

Jabłoński, M. J., Mirucka, B., Streb, J., Słowik, A. J., & Jach, R. (2019). Exploring the relationship between the body self and the sense of coherence in women after surgical treatment for breast cancer. *Psycho-Oncology*, *28*(1), 54–60. https://doi.org/10.1002/PON.4909

Jahn, A., Rump, A., Widmann, T. J., Heining, C., Horak, P., Hutter, B., Paramasivam, N., Uhrig, S., Gieldon, L., Drukewitz, S., Kübler, A., Bermudez, M., Hackmann, K., Porrmann, J., Wagner, J., Arlt, M., Franke, M., Fischer, J., Kowalzyk, Z., … Klink, B. (2022). Comprehensive cancer predisposition testing within the prospective MASTER trial identifies hereditary cancer patients and supports treatment decisions

for rare cancers. *Annals of Oncology : Official Journal of the European Society for Medical Oncology*, *33*(11), 1186–1199. https://doi.org/10.1016/J.ANNONC.2022.07.008

Jensen, J. D., King, A. J., Carcioppolo, N., Krakow, M., Samadder, N. J., & Morgan, S. (2014). Comparing tailored and narrative worksite interventions at increasing colonoscopy adherence in adults 50-75: A randomized controlled trial. *Social Science and Medicine*, *104*, 31–40. https://doi.org/10.1016/j.socscimed.2013.12.003

Jin, J., Wu, X., Yin, J., Li, M., Shen, J., Li, J., Zhao, Y., Zhao, Q., Wu, J., Wen, Q., Cho, C. H., Yi, T., Xiao, Z., & Qu, L. (2019). Identification of Genetic Mutations in Cancer: Challenge and Opportunity in the New Era of Targeted Therapy. *Frontiers in Oncology*, *9*(MAR), 263. https://doi.org/10.3389/FONC.2019.00263

Juan, A. S., Wakefield, C., Kasparian, N. A., Kirk, J., Tyler, J., & Tucker, K. (2008). Development and pilot testing of a decision aid for men considering genetic testing for breast and/or ovarian cancer-related mutations (BRCA1/2). *Genetic Testing*, *12*(4), 523–532. https://doi.org/10.1089/gte.2008.0035

Kaczor-Urbanowicz, K. E., Wei, F., Rao, S. L., Kim, J., Shin, H., Cheng, J., Tu, M., Wong, D. T. W., & Kim, Y. (2019). Clinical validity of saliva and novel technology for cancer detection. *Biochimica et Biophysica Acta (BBA) - Reviews on Cancer*, *1872*(1), 49–59. https://doi.org/10.1016/J.BBCAN.2019.05.007

Kahneman, D., & Tversky, A. (2013). *Prospect Theory: An Analysis of Decision Under Risk* (pp. 99–127). https://doi.org/10.1142/9789814417358_0006

Kim, H. K., & Lee, T. K. (2017). Conditional Effects of Gain–Loss-Framed Narratives among Current Smokers at Different Stages of Change. *Journal of Health Communication*, *22*(12), 990–998. https://doi.org/10.1080/10810730.2017.1396629

Kuchenbaecker, K. B., Hopper, J. L., Barnes, D. R., Phillips, K. A., Mooij, T. M., Roos-Blom, M. J., Jervis, S., Van Leeuwen, F. E., Milne, R. L., Andrieu, N., Goldgar, D. E., Terry, M. B., Rookus, M. A., Easton, D. F., & Antoniou, A. C. (2017). Risks of breast, ovarian, and contralateral breast cancer for BRCA1 and BRCA2 mutation carriers. *JAMA - Journal of the American Medical Association*, *317*(23), 2402–2416. https://doi.org/10.1001/JAMA.2017.7112

Kurian, A. W., & Katz, S. J. (2020). Emerging Opportunity of Cascade Genetic Testing for Population-Wide Cancer Prevention and Control. *Journal of Clinical Oncology : Official Journal of the American Society of Clinical Oncology*, *38*(13), 1371–1374. https://doi.org/10.1200/JCO.20.00140

LaDuca, H., Polley, E. C., Yussuf, A., Hoang, L., Gutierrez, S., Hart, S. N., Yadav, S., Hu, C., Na, J., Goldgar, D. E., Fulk, K., Smith, L. P., Horton, C., Profato, J., Pesaran, T., Gau, C. L., Pronold, M., Davis, B. T., Chao, E. C., … Dolinsky, J. S. (2020). A clinical guide to hereditary cancer panel testing: evaluation of gene-specific cancer associations and sensitivity of genetic testing criteria in a cohort of 165,000 high-risk patients. *Genetics in Medicine*, *22*(2), 407–415. https://doi.org/10.1038/S41436-019-0633-8

Lerman, C., & Schwartz, M. (1993). Adherence and psychological adjustment among women at high risk for breast cancer. *Breast Cancer Research and Treatment*, *28*(2), 145–155. https://doi.org/10.1007/BF00666427

Lieberman, S., Lahad, A., Tomer, A., Koka, S., BenUziyahu, M., Raz, A., & Levy-Lahad, E. (2018). Familial communication and cascade testing among relatives of BRCA population screening participants. *Genetics in Medicine*, *20*(11), 1446–1454. https://doi.org/10.1038/gim.2018.26

Liede, A., Metcalfe, K., Hanna, D., Hoodfar, E., Snyder, C., Durham, C., Lynch, H. T., & Narod, S. A. (2000). Evaluation of the Needs of Male Carriers of Mutations in BRCA1 or BRCA2 Who Have Undergone Genetic Counseling. *The American Journal of Human Genetics*, *67*(6), 1494–1504. https://doi.org/10.1086/316907

Lippke, S., & Ziegelmann, J. P. (2008). Theory-Based Health Behavior Change: Developing, Testing, and Applying Theories for Evidence-Based Interventions. *Applied Psychology*, *57*(4), 698–716. https://doi.org/10.1111/J.1464-0597.2008.00339.X

Lodder, L., Frets, P. G., Trijsburg, R. W., Tibben, A., Meijers-Heijboer, E. J., Duivenvoorden, H. J., Wagner, A., Van Der Meer, C. A., Devilee, P., Cornelisse, C. J., & Niermeijer, M. F. (2001). Men at risk of being a mutation carrier for hereditary breast/ovarian cancer: An exploration of attitudes and psychological functioning during genetic testing. *European Journal of Human Genetics*, *9*(7), 492–500. https://doi.org/10.1038/sj.ejhg.5200668

Luszczynska, A., Schwarzer, R., Lippke, S., & Mazurkiewicz, M. (2011). Self-efficacy as a moderator of the planning-behaviour relationship in interventions designed to promote physical activity. *Psychology and Health*, *26*(2), 151–166. https://doi.org/10.1080/08870446.2011.531571

Lutter, J. I., Szentes, B., Wacker, M. E., Winter, J., Wichert, S., Peters, A., Holle, R., & Leidl, R. (2019). Are health risk attitude and general risk attitude associated with

healthcare utilization, costs and working ability? Results from the German KORA FF4 cohort study. *Health Economics Review*, *9*(1), 1–11. https://doi.org/10.1186/S13561-019-0243-9/TABLES/6

Lynch, H. T., & de la Chapelle, A. (2003). Hereditary colorectal cancer. *The New England Journal of Medicine*, *348*(10), 919–932. https://doi.org/10.1056/NEJMRA012242

Maheri, M., Rezapour, B., & Didarloo, A. (2022). Predictors of colorectal cancer screening intention based on the integrated theory of planned behavior among the average-risk individuals. *BMC Public Health*, *22*(1), 1–11. https://doi.org/10.1186/S12889-022-14191-9/TABLES/6

Mahon, S. M. (2014). Cancer risks for men with BRCA1/2 mutations. *Oncology Nursing Forum*, *41*(1), 99–101. https://doi.org/10.1188/14.ONF.99-101

Mak, W. W. S., Chan, A. T. Y., Cheung, E. Y. L., Lin, C. L. Y., & Ngai, K. C. S. (2015). Enhancing Web-Based Mindfulness Training for Mental Health Promotion With the Health Action Process Approach: Randomized Controlled Trial. *Journal of Medical Internet Research*, *17*(1), e3746. https://doi.org/10.2196/JMIR.3746

Mandelker, D., Zhang, L., Kemel, Y., Stadler, Z. K., Joseph, V., Zehir, A., Pradhan, N., Arnold, A., Walsh, M. F., Li, Y., Balakrishnan, A. R., Syed, A., Prasad, M., Nafa, K., Carlo, M. I., Cadoo, K. A., Sheehan, M., Fleischut, M. H., Salo-Mullen, E., … Offit, K. (2017). Mutation Detection in Patients With Advanced Cancer by Universal Sequencing of Cancer-Related Genes in Tumor and Normal DNA vs Guideline-Based Germline Testing. *JAMA*, *318*(9), 825–835. https://doi.org/10.1001/JAMA.2017.11137

Marabelli, M., Calvello, M., & Bonanni, B. (2019). Test more men for BRCA genes. *Nature*, *573*, 346.

Mastellos, N., Gunn, L. H., Felix, L. M., Car, J., & Majeed, A. (2014). Transtheoretical model stages of change for dietary and physical exercise modification in weight loss management for overweight and obese adults. *Cochrane Database of Systematic Reviews*, *2014*(2). https://doi.org/10.1002/14651858.CD008066.PUB3/MEDIA/CDSR/CD008066/IMAGE_N/NCD008066-AFIG-FIG03.PNG

Mata, R., Frey, R., Richter, D., Schupp, J., & Hertwig, R. (2018). Risk preference: A view from psychology. *Journal of Economic Perspectives*, *32*(2), 155–172. https://doi.org/10.1257/JEP.32.2.155

McAllister, M. F., Evans, D. G. R., Ormiston, W., & Daly, P. (1998). Men in breast cancer

families: A preliminary qualitative study of awareness and experience. *Journal of Medical Genetics*, *35*(9), 739–744. https://doi.org/10.1136/jmg.35.9.739

Meiser, B. (2005). Psychological impact of genetic testing for cancer susceptibility: An update of the literature. *Psycho-Oncology*, *14*(12), 1060–1074. https://doi.org/10.1002/PON.933

Mersch, J., Jackson, M. A., Park, M., Nebgen, D., Peterson, S. K., Singletary, C., Arun, B. K., & Litton, J. K. (2015). Cancers associated with BRCA1 and BRCA2 mutations other than breast and ovarian. *Cancer*, *121*(2), 269–275. https://doi.org/10.1002/CNCR.29041

Metcalfe, K. A., Lubinski, J., Gronwald, J., Huzarski, T., McCuaig, J., Lynch, H. T., Karlan, B., Foulkes, W. D., Singer, C. F., Neuhausen, S. L., Senter, L., Eisen, A., Sun, P., & Narod, S. A. (2018). The risk of breast cancer in BRCA1 and BRCA2 mutation carriers without a first-degree relative with breast cancer. *Clinical Genetics*, *93*(5), 1063–1068. https://doi.org/10.1111/CGE.13191

Myers, L., Goodwin, B., Ralph, N., & March, S. (2022). A health action process approach for developing invitee endorsed interventions to increase mail-out bowel cancer screening. *Applied Psychology: Health and Well-Being*, *14*(3), 776–794. https://doi.org/10.1111/APHW.12346

Nagy, R., Sweet, K., & Eng, C. (2004). Highly penetrant hereditary cancer syndromes. *Oncogene 2004 23:38*, *23*(38), 6445–6470. https://doi.org/10.1038/sj.onc.1207714

Nyberg, T., Frost, D., Barrowdale, D., Evans, D. G., Bancroft, E., Adlard, J., Ahmed, M., Barwell, J., Brady, A. F., Brewer, C., Cook, J., Davidson, R., Donaldson, A., Eason, J., Gregory, H., Henderson, A., Izatt, L., Kennedy, M. J., Miller, C., … Antoniou, A. C. (2020). Prostate Cancer Risks for Male BRCA1 and BRCA2 Mutation Carriers: A Prospective Cohort Study. *European Urology*, *77*(1), 24–35. https://doi.org/10.1016/j.eururo.2019.08.025

O'Keefe, D. J., & Jensen, J. D. (2016). The Advantages of Compliance or the Disadvantages of Noncompliance? A Meta-Analytic Review of the Relative Persuasive Effectiveness of Gain-Framed and Loss-Framed Messages. *Annals of the International Communication Association*, *30*(1), 1–43. https://doi.org/10.1080/23808985.2006.11679054

O'Neill, S. C., Hamilton, J. G., Conley, C. C., Peshkin, B. N., Sacca, R., McDonnell, G. A., Isaacs, C., Robson, M. E., & Tercyak, K. P. (2021). Improving our model of cascade testing for hereditary cancer risk by leveraging patient peer support: a

concept report. *Hereditary Cancer in Clinical Practice*, *19*(1). https://doi.org/10.1186/S13053-021-00198-7

Offit, K., Tkachuk, K. A., Stadler, Z. K., Walsh, M. F., Diaz-Zabala, H., Levin, J. D., Steinsnyder, Z., Ravichandran, V., Sharaf, R. N., Frey, M. K., Lipkin, S. M., Robson, M. E., Hamilton, J. G., Vijai, J., & Mukherjee, S. (2020). Cascading After Peridiagnostic Cancer Genetic Testing: An Alternative to Population-Based Screening. *Journal of Clinical Oncology : Official Journal of the American Society of Clinical Oncology*, *38*(13), 1398–1408. https://doi.org/10.1200/JCO.19.02010

Oliveri, S., Cincidda, C., Ongaro, G., Cutica, I., Gorini, A., Spinella, F., Fiorentino, F., Baldi, M., & Pravettoni, G. (2021). What people really change after genetic testing (GT) performed in private labs: results from an Italian study. *European Journal of Human Genetics 2021*, 1–11. https://doi.org/10.1038/s41431-021-00879-w

Oliveri, S., Ferrari, F., Manfrinati, A., & Pravettoni, G. (2018). A Systematic Review of the Psychological Implications of Genetic Testing: A Comparative Analysis Among Cardiovascular, Neurodegenerative and Cancer Diseases. *Frontiers in Genetics*, *9*. https://doi.org/10.3389/fgene.2018.00624

Oliveri, S., Masiero, M., Arnaboldi, P., Cutica, I., Fioretti, C., & Pravettoni, G. (2016). Health Orientation, Knowledge, and Attitudes toward Genetic Testing and Personalized Genomic Services: Preliminary Data from an Italian Sample. *BioMed Research International*, *2016*, 1–9. https://doi.org/10.1155/2016/6824581

Oliveri, S., Pravettoni, G., Fioretti, C., & Hansson, M. G. (2016). Let the Individuals Directly Concerned Decide: A Solution to Tragic Choices in Genetic Risk Information. *Public Health Genomics*, *19*(5), 307–313. https://doi.org/10.1159/000448913

Ongaro, G., Brivio, E., Cincidda, C., Oliveri, S., Spinella, F., Steinberger, D., Cutica, I., Gorini, A., & Pravettoni, G. (2022). Genetic testing users in Italy and Germany: Health orientation, health-related habits, and psychological profile. *Molecular Genetics & Genomic Medicine*, e1851. https://doi.org/10.1002/MGG3.1851

Ongaro, G., Petrocchi, S., Calvello, M., Bonanni, B., Feroce, I., & Pravettoni, G. (2022). Psychological Determinants of Men's Adherence to Cascade Screening for BRCA1/2. *Current Oncology*, *29*(4), 2490–2503. https://doi.org/10.3390/CURRONCOL29040203

Parschau, L., Barz, M., Richert, J., Knoll, N., Lippke, S., & Schwarzer, R. (2014). Physical activity among adults with obesity: Testing the health action process

approach. *Rehabilitation Psychology*, *59*(1), 42–49. https://doi.org/10.1037/a0035290

Peshkin, B. N., Ladd, M. K., Isaacs, C., Segal, H., Jacobs, A., Taylor, K. L., Graves, K. D., O'Neill, S. C., & Schwartz, M. D. (2021). The Genetic Education for Men (GEM) Trial: Development of Web-Based Education for Untested Men in BRCA1/2-Positive Families. *Journal of Cancer Education*, *36*(1), 72–84. https://doi.org/10.1007/S13187-019-01599-Y/TABLES/4

Petrocchi, S., Iannello, P., Ongaro, G., Antonietti, A., & Pravettoni, G. (2021). The interplay between risk and protective factors during the initial height of the COVID-19 crisis in Italy: The role of risk aversion and intolerance of ambiguity on distress. *Current Psychology*, 1–12. https://doi.org/10.1007/s12144-021-01601-1

Petrocchi, S., Ludolph, R., Labrie, N., & Schulz, P. (2020). Application of the theory of regulatory fit to promote adherence to evidence-based breast cancer screening recommendations: experimental versus longitudinal evidence. *BMJ Open*, *10*(11). https://doi.org/10.1136/BMJOPEN-2020-037748

Petrucelli, N., Daly, M. B., & Pal, T. (1993). BRCA1- and BRCA2-Associated Hereditary Breast and Ovarian Cancer. In *GeneReviews®*. University of Washington, Seattle.

Petrucelli, N., Daly, M. B., & Pal, T. (2022). BRCA1- and BRCA2-Associated Hereditary Breast and Ovarian Cancer. *GeneReviews®*.

Pourhaji, F., Delshad, M. H., & Pourhaji, F. (2021). *Application of the Health Action Process Approach Model in Predicting Mammography among Iranian Women*. https://doi.org/10.21203/RS.3.RS-80108/V1

Pritchard, C. C. (2019). New name for breast-cancer syndrome could help to save lives. In *Nature* (Vol. 571, Issue 7763, pp. 27–29). Nature Research. https://doi.org/10.1038/d41586-019-02015-7

Prochaska, J. O., & Di Clemente, C. C. (1982). Transtheoretical therapy: Toward a more integrative model of change. *Psychotherapy*, *19*(3), 276–288. https://doi.org/10.1037/h0088437

Prochaska, J. O., Di Clemente, C., & Norcross, C. (1992). In search of how people change. Applications to addictive behaviors. *The American Psychologist*, *47*(9), 1102–1114. https://doi.org/10.1037//0003-066X.47.9.1102

Pruthi, S., Gostout, B. S., & Lindor, N. M. (2010). Identification and Management of Women With BRCA Mutations or Hereditary Predisposition for Breast and Ovarian Cancer. *Mayo Clinic Proceedings*, *85*(12), 1111.

https://doi.org/10.4065/MCP.2010.0414

Quincey, K., Williamson, I., & Winstanley, S. (2016). 'Marginalised malignancies': A qualitative synthesis of men's accounts of living with breast cancer. *Social Science & Medicine*, *149*, 17–25. https://doi.org/10.1016/J.SOCSCIMED.2015.11.032

Radtke, T., Scholz, U., Keller, R., & Hornung, R. (2012). Smoking is ok as long as I eat healthily: Compensatory Health Beliefs and their role for intentions and smoking within the Health Action Process Approach. *Psychology and Health*, *27*(SUPPL. 2), 91–107. https://doi.org/10.1080/08870446.2011.603422

Rantala, J., Platten, U., Lindgren, G., Nilsson, B., Arver, B., Lindblom, A., & Brandberg, Y. (2009). Risk perception after genetic counseling in patients with increased risk of cancer. *Hereditary Cancer in Clinical Practice*, *7*(1), 1–14. https://doi.org/10.1186/1897-4287-7-15/FIGURES/6

Rauscher, E. A., Dean, M., Campbell-Salome, G., & Barbour, J. B. (2019). "How do we rally around the one who was positive?" Familial uncertainty management in the context of men managing BRCA-related cancer risks. *Social Science & Medicine*, *242*, 112592. https://doi.org/10.1016/j.socscimed.2019.112592

Rauscher, E. A., Dean, M., & Campbell-Salome, G. M. (2018). "I Am Uncertain About What My Uncertainty Even Is": Men's Uncertainty and Information Management of Their BRCA-Related Cancer Risks. *Journal of Genetic Counseling*, *27*(6), 1417–1427. https://doi.org/10.1007/s10897-018-0276-y

Reichelt, J. G., Heimdal, K., Møller, P., & Dahl, A. A. (2004). BRCA1 testing with definitive results: A prospective study of psychological distress in a large clinic-based sample. *Familial Cancer*, *3*(1), 21–28. https://doi.org/10.1023/B:FAME.0000026820.32469.4A/METRICS

Renner, B. (2003). Hindsight bias after receiving self-relevant health risk information: A motivational perspective. *Memory*, *11*(4–5), 455–472. https://doi.org/10.1080/09658210244000531

Renner, B. (2004). Biased Reasoning: Adaptive Responses to Health Risk Feedback. *Personality and Social Psychology Bulletin*, *30*(3), 384–396. https://doi.org/10.1177/0146167203261296

Ringwald, J., Wochnowski, C., Bosse, K., Giel, K. E., Schäffeler, N., Zipfel, S., & Teufel, M. (2016). Psychological Distress, Anxiety, and Depression of Cancer-Affected BRCA1/2 Mutation Carriers: a Systematic Review. *Journal of Genetic Counseling*, *25*(5), 880–891. https://doi.org/10.1007/S10897-016-9949-6

Roberts, M. C., Dotson, W. D., DeVore, C. S., Bednar, E. M., Bowen, D. J., Ganiats, T. G., Green, R. F., Hurst, G. M., Philp, A. R., Ricker, C. N., Sturm, A. C., Trepanier, A. M., Williams, J. L., Zierhut, H. A., Wilemon, K. A., & Hampel, H. (2018). Delivery Of Cascade Screening For Hereditary Conditions: A Scoping Review Of The Literature. *Health Affairs (Project Hope)*, *37*(5), 801–808. https://doi.org/10.1377/HLTHAFF.2017.1630

Roberts, M. C., Taber, J. M., & Klein, W. M. (2018). Engagement with Genetic Information and Uptake of Genetic Testing: the Role of Trust and Personal Cancer History. *Journal of Cancer Education : The Official Journal of the American Association for Cancer Education*, *33*(4), 893–900. https://doi.org/10.1007/S13187-016-1160-9

Rosen, N. O., Knäuper, B., & Sammut, J. (2007). Do individual differences in intolerance of uncertainty affect health monitoring? *Psychology and Health*. https://doi.org/10.1080/14768320600941038

Ross Arguedas, A., Scherr, C. L., Dean, M., Getachew-Smith, H., & Clements, M. (2020). Intersections of health and gender imperatives: stratified decision-making among women with a BRCA mutation. *BioSocieties*, *15*(2), 245–269. https://doi.org/10.1057/S41292-019-00154-8/TABLES/1

Roukos, D. H., Kappas, A. M., & Tsianos, E. (2002). Role of surgery in the prophylaxis of hereditary cancer syndromes. *Annals of Surgical Oncology*, *9*(7), 607–609. https://doi.org/10.1007/BF02574474

Schapira, M. M., Aggarwal, C., Akers, S., Aysola, J., Imbert, D., Langer, C., Simone, C. B., Strittmatter, E., Vachani, A., & Fraenkel, L. (2016). How patients view lung cancer screening: The role of uncertainty in medical decision making. *Annals of the American Thoracic Society*, *13*(11), 1969–1976. https://doi.org/10.1513/AnnalsATS.201604-290OC

Scholz, U., Keller, R., & Perren, S. (2009). Predicting behavioral intentions and physical exercise: A test of the health action process approach at the intrapersonal level. *Health Psychology*, *28*(6), 702–708. https://doi.org/10.1037/a0016088

Scholz, U., Nagy, G., Göhner, W., Luszczynska, A., & Kliegel, M. (2009). Changes in self-regulatory cognitions as predictors of changes in smoking and nutrition behaviour. *Psychology and Health*, *24*(5), 545–561. https://doi.org/10.1080/08870440801902519

Schwarzer, R. (2016). Health Action Process Approach (HAPA) as a Theoretical

Framework to Understand Behavior Change. *Actualidades En Psicología*. https://doi.org/10.15517/ap.v30i121.23458

Schwarzer, R., & Luszczynska, A. (2008). The Health Action Process Approach. *European Psychologist*, *13*(2), 141–151. https://doi.org/10.1027/1016-9040.13.2.141

Sermijn, E., Goelen, G., Teugels, E., Kaufman, L., Bonduelle, M., Neyns, B., Poppe, B., De Paepe, A., & De Grève, J. (2004). The impact of proband mediated information dissemination in families with a BRCA1/2 gene mutation. *Journal of Medical Genetics*, *41*(3). https://doi.org/10.1136/JMG.2003.011353

Seven, M., Shah, L. L., Daack-Hirsch, S., & Yazici, H. (2021). Experiences of BRCA1/2 Gene Mutation-Positive Women With Cancer in Communicating Genetic Risk to Their Relatives. *Cancer Nursing*, *44*(3), E142–E150. https://doi.org/10.1097/NCC.0000000000000796

Shi, J. (Jolie), & Smith, S. W. (2016). The effects of fear appeal message repetition on perceived threat, perceived efficacy, and behavioral intention in the extended parallel process model. *Health Communication*, *31*(3), 275–286. https://doi.org/10.1080/10410236.2014.948145

Shiloh, S., Dagan, E., Friedman, I., Blank, N., & Friedman, E. (2013). A follow-up study on men tested for BRCA1/BRCA2 mutations: impacts and coping processes. *Psycho-Oncology*, *22*(2), 417–425. https://doi.org/10.1002/PON.2106

Shiloh, S., Drori, E., Orr-Urtreger, A., & Friedman, E. (2009). Being 'at-risk' for developing cancer: Cognitive representations and psychological outcomes. *Journal of Behavioral Medicine*, *32*(2), 197–208. https://doi.org/10.1007/S10865-008-9178-Z

Shim, M., Kelly, B., & Hornik, R. (2006). Cancer information scanning and seeking behavior is associated with knowledge, lifestyle choices, and screening. *Journal of Health Communication*, *11*(SUPPL. 1), 157–172. https://doi.org/10.1080/10810730600637475

Skop, M., Lorentz, J., Jassi, M., Vesprini, D., & Einstein, G. (2018). "Guys Don't Have Breasts": The Lived Experience of Men Who Have BRCA GeneMutations and Are at Risk for Male Breast Cancer. *American Journal of Men's Health*, *12*(4), 961. https://doi.org/10.1177/1557988317753241

Smajic, E., Avdic, D., Pasic, A., Prcic, A., & Stancic, M. (2022). Mixed Methodology of Scientific Research in Healthcare. *Acta Informatica Medica*, *30*(1), 57.

https://doi.org/10.5455/AIM.2022.30.57-60

Smith, J. R., Murray, N. J., Greaves, C., Hooper, L., & Abraham, C. (2014). A Systematic Review of Intervention Studies Using Health Action Process Approach (HAPA) Model Components to Prevent and Manage Chronic Diseases. *European Health Psychologist*, 616–616.

Spector, D. (2007). Lifestyle Behaviors in Women With a BRCA1 or BRCA2 Genetic Mutation. *Cancer Nursing*, *30*(1), E1–E10. https://doi.org/10.1097/00002820-200701000-00015

Spencer, L., Pagell, F., & Adams, T. (2005). Applying the Transtheoretical Model to Cancer Screening Behavior. *American Journal of Health Behavior*, *29*(1), 36–56. https://doi.org/10.5993/AJHB.29.1.4

Srinivasan, S., Won, N. Y., Dotson, W. D., Wright, S. T., & Roberts, M. C. (2020). Barriers and facilitators for cascade testing in genetic conditions: a systematic review. *European Journal of Human Genetics : EJHG*, *28*(12), 1631–1644. https://doi.org/10.1038/S41431-020-00725-5

Steca, P., Pancani, L., Greco, A., D'Addario, M., Magrin, M. E., Miglioretti, M., Sarini, M., Scrignaro, M., Vecchio, L., Cesana, F., Giannattasio, C., Fattirolli, F., & Zanettini, R. (2015). Changes in Dietary Behavior among Coronary and Hypertensive Patients: A Longitudinal Investigation Using the Health Action Process Approach. *Applied Psychology: Health and Well-Being*, *7*(3), 316–339. https://doi.org/10.1111/aphw.12050

Strømsvik, N., Råheim, M., & Gjengedal, E. (2011). Cancer worry among Norwegian male BRCA1/2 mutation carriers. *Familial Cancer*, *10*(3), 597–603. https://doi.org/10.1007/S10689-011-9456-8

Strømsvik, N., Råheim, M., Øyen, N., Engebretsen, L. F., & Gjengedal, E. (2010). Stigmatization and male identity: Norwegian males' experience after identification as BRCA1/2 mutation carriers. *Journal of Genetic Counseling*, *19*(4), 360–370. https://doi.org/10.1007/s10897-010-9293-1

Strømsvik, N., Råheim, M., Yen, N., & Gjengedal, E. (2009). Men in the women's world of hereditary breast and ovarian cancer-a systematic review. *Familial Cancer*, *8*(3), 221–229. https://doi.org/10.1007/s10689-009-9232-1

Suka, M., Yamauchi, T., & Yanagisawa, H. (2020). Persuasive messages can be more effective when repeated: A comparative survey assessing a message to seek help for depression among Japanese adults. *Patient Education and Counseling*, *103*(4), 811–

818. https://doi.org/10.1016/J.PEC.2019.11.008

Suttman, A., Pilarski, R., Agnese, D. M., & Senter, L. (2018). 'Second-Class Status?' Insight into Communication Patterns and Common Concerns Among Men with Hereditary Breast and Ovarian Cancer Syndrome. *Journal of Genetic Counseling*, *27*(4), 885–893. https://doi.org/10.1007/S10897-018-0214-Z

Sutton, S. (2008). How does the Health Action Process Approach (HAPA) Bridge the Intention–Behavior Gap? An Examination of the Model's Causal Structure. *Applied Psychology*, *57*(1), 66–74. https://doi.org/10.1111/J.1464-0597.2007.00326.X

Taber, J. M., Klein, W. M. P., Ferrer, R. A., Han, P. K. J., Lewis, K. L., Biesecker, L. G., & Biesecker, B. B. (2015). Perceived ambiguity as a barrier to intentions to learn genome sequencing results. *Journal of Behavioral Medicine*, *38*(5), 715–726. https://doi.org/10.1007/s10865-015-9642-5

Tai, Y. C., Domchek, S., Parmigiani, G., & Chen, S. (2007). Breast Cancer Risk Among Male BRCA1 and BRCA2 Mutation Carriers. *Journal of the National Cancer Institute*, *99*(23), 1811. https://doi.org/10.1093/JNCI/DJM203

Taieb, J., Svrcek, M., Cohen, R., Basile, D., Tougeron, D., & Phelip, J. M. (2022). Deficient mismatch repair/microsatellite unstable colorectal cancer: Diagnosis, prognosis and treatment. *European Journal of Cancer*, *175*, 136–157. https://doi.org/10.1016/J.EJCA.2022.07.020

Tan, H.-J., Marks, L. S., Hoyt, M. A., Kwan, L., Filson, C. P., Macairan, M., Lieu, P., Litwin, M. S., & Stanton, A. L. (2016). The Relationship between Intolerance of Uncertainty and Anxiety in Men on Active Surveillance for Prostate Cancer. *Journal of Urology*, *195*(6), 1724–1730. https://doi.org/10.1016/j.juro.2016.01.108

Teleki, S., Zsidó, A. N., Komócsi, A., Lénárd, L., Kiss, E. C., & Tiringer, I. (2018). The role of social support in the dietary behavior of coronary heart patients: an application of the health action process approach. *Psychology, Health & Medicine*, *24*(6), 714–724. https://doi.org/10.1080/13548506.2018.1550259

Tormala, Z. L. (2016). The role of certainty (and uncertainty) in attitudes and persuasion. *Current Opinion in Psychology*, *10*, 6–11. https://doi.org/10.1016/J.COPSYC.2015.10.017

Trevisan, L., Godino, L., Battistuzzi, L., Iannella, G., Luppi, E., Buzzatti, G., Gismondi, V., Blondeaux, E., Ada Bonelli, L., Turchetti, D., & Varesco, L. (2023). *Cascade testing in Italian Hereditary Breast Ovarian Cancer families: a missed opportunity for cancer prevention?* https://doi.org/10.21203/RS.3.RS-3153904/V1

Van Osch, S. M. C., & Stiggelbout, A. M. (2007). *The development of the Health-Risk Attitude Scale*.

van Peer, W., & Maat, H. P. (2001). Narrative perspective and the interpretation of characters' motives. *Language and Literature: International Journal of Stylistics*, *10*(3), 229–241. https://doi.org/10.1177/0973-9470-20010803-04

Vos, J., Oosterwijk, J. C., Gomez-Garcia, E., Menko, F. H., Collee, M. J., van Asperen, C. J., Jansen, A. M., Stiggelbout, A. M., & Tibben, A. (2012). Exploring the short-term impact of DNA-testing in breast cancer patients: The counselees' perception matters, but the actual BRCA1/2 result does not. *Patient Education and Counseling*, *86*(2), 239–251. https://doi.org/10.1016/J.PEC.2011.04.017

Waarts, M. R., Stonestrom, A. J., Park, Y. C., & Levine, R. L. (2022). Targeting mutations in cancer. *The Journal of Clinical Investigation*, *132*(8). https://doi.org/10.1172/JCI154943

Walker, M., Jacobson, M., & Sobel, M. (2019). Management of ovarian cancer risk in women with BRCA1/2 pathogenic variants. *CMAJ : Canadian Medical Association Journal*, *191*(32), E886. https://doi.org/10.1503/CMAJ.190281

Weber, E. U., Blais, A. R., & Betz, N. E. (2002). A Domain-specific Risk-attitude Scale: Measuring Risk Perceptions and Risk Behaviors. *Journal of Behavioral Decision Making*. https://doi.org/10.1002/bdm.414

Young, A. L., Butow, P. N., Vetsch, J., Quinn, V. F., Patenaude, A. F., Tucker, K. M., & Wakefield, C. E. (2017). Family Communication, Risk Perception and Cancer Knowledge of Young Adults from BRCA1/2 Families: a Systematic Review. *Journal of Genetic Counseling*, *26*(6), 1179–1196. https://doi.org/10.1007/S10897-017-0125-4/TABLES/2

Zarski, A. C., Berking, M., Reis, D., Lehr, D., Buntrock, C., Schwarzer, R., & Ebert, D. D. (2018). Turning Good Intentions Into Actions by Using the Health Action Process Approach to Predict Adherence to Internet-Based Depression Prevention: Secondary Analysis of a Randomized Controlled Trial. *Journal of Medical Internet Research*, *20*(1), e8814. https://doi.org/10.2196/JMIR.8814

Zebregs, S., van den Putte, B., Neijens, P., & de Graaf, A. (2015). The Differential Impact of Statistical and Narrative Evidence on Beliefs, Attitude, and Intention: A Meta-Analysis. *Health Communication*, *30*(3), 282–289. https://doi.org/10.1080/10410236.2013.842528

Zeidi, I. M., Morshedi, H., & Shokohi, A. (2020). Application of the Health Action

Process Approach (HAPA) Model to Determine Factors Affecting Physical Activity in Hypertensive Patients. *Journal of Jiroft University of Medical Sciences*, *7*(2), 349–360.

Zhang, C. Q., Zhang, R., Schwarzer, R., & Hagger, M. S. (2019). A Meta-Analysis of the Health Action Process Approach. *Health Psychology*, *38*(7), 623–637. https://doi.org/10.1037/hea0000728

Zhang, C., Zheng, X., Huang, H., Su, C., Zhao, H., Yang, H., Guo, Y., & Pan, X. (2018). A Study on the Applicability of the Health Action Process Approach to the Dietary Behavior of University Students in Shanxi, China. *Journal of Nutrition Education and Behavior*, *50*(4), 388-395.e1. https://doi.org/10.1016/J.JNEB.2017.09.024

Appendix

My name is Matthew and some time ago my sister was diagnosed with breast cancer. A
After a genetic test, she was found to be **a carrier** of a genetic mutation in a **BRCA gene.**
There are two BRCA genes: **BRCA1 and BRCA2**. The presence of a mutation in one of these genes is associated with a **higher risk** of developing **cancer** in some organs (**breast, ovary, pancreas and prostate**) than in those without the mutation.
Both **men and women** can have BRCA1 or BRCA2 mutations. These mutations can be passed on **from parents to children**.
having a mutation does not necessarily mean to develop a tumor, but to have a **greater predisposition** to develop it.
I decided to undergo genetic test because I think **it's important to me.** They took my blood, got DNA from the sample and detected the presence of the previously identified mutation in my family.
What are the advantages of genetic testing?
Whilst I discovered that I have a higher risk of developing certain forms of cancer in the future, the advantage of genetic testing and knowing that I have a mutated gene is that now I can **implement preventive behaviors** (more controls, lifestyle change).
I think **my health** has benefited from the decision I made to undergo the test and from the identification of the mutation.
Prostate
Pancreas
Breast

ndix I. Self-referred narrative message brochure.

Appendix I. Family-referred narrative message brochure.