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The impact of familial environment on depression scores after genetic testing for cancer susceptibility

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Abstract

Purpose—The associations between characteristics of family relationships and family trends in cancer worry and the psychological adjustment of recipients of genetic testing for cancer susceptibility were investigated.

Methods—Data provided by 178 individuals from 24 families with Lynch syndrome who participated in a cohort study investigating psychological and behavioral outcomes of genetic testing were used. Responses from multiple family members were aggregated to construct family trends representing norms and departure from norms in cancer worry.

Results—Lower perceived family cohesion at baseline and decrease in this variable at 6-months after receipt of test results were associated with higher depression scores at 12-months. More variability in cancer worry among family members at baseline was also associated with higher depression scores at 12-months. Increase in family conflict was associated with decrease in depression scores among individuals from families with higher levels of cancer worry on average and less variability among the members.

Conclusions—Family relationships and family trends in levels of cancer worry may play important roles in the psychological adjustment of genetic test recipients. The findings highlight the complexity of familial environment surrounding individuals that undergo genetic testing and suggest the benefits of considering these factors when providing genetic services.

Keywords

cancer worry; CES-D; family relationships; genetic testing; Hereditary Nonpolyposis Colorectal Cancer; Lynch syndrome; social environment

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INTRODUCTION

The Family System Genetic Illness model postulates the importance of a family-centered approach in understanding the impacts of genetically influenced illnesses on coping and adaptation of family members due to the presence of future disease risk for multiple family members (1). When mutations associated with hereditary disorders are identified, this information inevitably concerns multiple members of the family. Consequently, disclosure of genetic test results influences family relationships as well as the overall family environment (1,2). In one study, approximately 37% of those who underwent genetic testing for Hereditary Nonpolyposis Colorectal Cancer (HNPCC) reported positive changes in family relationships while 19% reported negative changes (2), suggesting that provision of genetic test results acts as a stressor for some families.

About 2% to 5% of all colorectal cancer cases in the U.S. are estimated to be due to Lynch Syndrome, also known as HNPCC (3). This is an autosomal dominant cancer susceptibility syndrome with estimated cumulative risk of developing the associated cancers (colorectal, endometrial, ovarian cancer and others) ranging between 47% and 85% if appropriate preventive screenings are not performed (4). For families who are affected by Lynch Syndrome, knowing whether they carry a mutation in one of the associated mismatch repair genes (*MLH1*, *MSH2*, *MSH6* and *PMS2*) can be beneficial so that appropriate surveillance to prevent the onset of or identify a cancer at an earlier stage can be carried out (5). Increased surveillance among carriers has been found to reduce the mortality and morbidity of associated cancers (6).

Despite these benefits, knowing mutation status may also lead to psychological distress among individuals because of the high estimated lifetime risks for developing an associated cancer (7–9). While some evidence suggests no long-term adverse psychological effects of genetic testing (10,11), short-term changes in distress among recipients of genetic testing in mismatch repair genes have been reported (12). Therefore, health professionals providing genetic testing services are expected to help recipients to anticipate their psychological reactions prior to testing (13–15).

Recipients of genetic tests may share the results with their family members not only to inform others but also to activate family resources to facilitate coping (16). When multiple family members have been tested, distress levels have differed depending on whether and how many other family members received the same test results (17). Furthermore, the structure of the familial social support system has been shown to be associated with psychological adaptation to the given risk levels among women who are affected by hereditary breast and ovarian cancer (18). These findings suggest that family relationships and social context influence coping strategies and, ultimately, psychological adjustment of genetic test recipients.

Sharing of health-related beliefs among family members is thought to be one of the family characteristics associated with the outcomes of genetic testing (19). Such beliefs, shaped by a family's past experiences, may lead to anticipatory distress associated with genetic test results (20,21). Children of women who were distressed before receiving *BRCA1/2* testing reported higher levels of worry about cancer than those who had mothers with lower distress levels (22). Within families carrying *BRCA1/2* mutations, members were found to share similar levels of cancer worry regardless of mutation carrier status (18). The norm of cancer worry within the family, as well as the extent of deviations from this norm among family members, create a cultural context within which individual family members relate to each other and adapt to their shared hereditary risk. In families that undergo genetic testing for Lynch syndrome, high levels of cancer worry shared among family members may create an environment where conflictual relationships are particularly maladaptive leading to increase in psychological distress.

Currently, limited information is available to determine how family-level characteristics impact the psychological outcomes of genetic testing (19). Understanding the role of family relationships in the psychological adjustment to genetic test results may help health professionals in identifying families that would benefit from additional interventions and in developing strategies to minimize psychological distress among test recipients. The studies introduced above explored the impact of genetic test results on family relationships. The current study adds to the literature by investigating the role of family relationships on genetic test recipients' psychological adjustment, and by exploring how family trends in cancer worry influence this association.

The main objectives of this study were: (1) to investigate the associations between perceived family relationships before genetic testing as well as changes in perceptions 6 months after results disclosure and the changes in depression scores over a 12-month period after disclosure; and (2) to evaluate the moderating effect of family norms and discrepancy in worry about cancer on these associations.

METHODS

Population

Participants in this study were identified from an ongoing longitudinal cohort study of families with Lynch syndrome to investigate the outcomes of genetic counseling and testing for known, deleterious mismatch repair mutations (23). Family members at risk for inheriting a deleterious (unequivocal) mutation were recruited through participating family members. Families with 3 or more participating members were included in these analyses, a total of 178 individuals from 24 families.

Design/Procedures

The study was approved through the Institutional Review Boards of the participating institutions. All participants gave their informed consent. The individuals included in the current analyses participated in comprehensive and scripted genetic education and counseling sessions and chose to undertake genetic testing. Participants completed survey questionnaires prior to receiving genetic education and counseling (baseline), and at 6- and 12-months after disclosure of the genetic testing results. Participants provided blood samples that were processed in a Clinical Laboratory Improvement Amendment (CLIA) – approved laboratory. Results were disclosed in person about 1 to 2 months after sample collection along with printed cancer screening recommendations and internet-based resources on preventive strategies.

Variables

Depressive Symptoms—The Center for Epidemiology Studies – Depression Scale (CES-D) was used at all 3 assessment time points (24). The scores range between 0 and 60 with higher scores indicating higher levels of depressive symptoms (Cronbach alphas = 0.89, 0.88, and 0.93 for baseline, 6-, and 12-month respectively).

Family Relationships—Three subscales from the Family Environment Scale (FES) (25), cohesion ($\alpha = 0.72$ and 0.73 for baseline and 6-month respectively), expressiveness ($\alpha = 0.50$, 0.49), and conflict ($\alpha = 0.75$, 0.69), were used to evaluate participants' perceptions about family relationships at baseline and 6 months after genetic testing result disclosure. The sum scores range between 0 and 9 for each subscale, higher scores indicating higher levels of cohesion, expressiveness, and conflict, respectively. Baseline scores as well as change scores (6-month minus baseline) were used. Change scores represent the effect of genetic testing on family relationships.

Cancer Worry—Cancer worries ($\alpha = 0.64$) were assessed using tools validated in previous studies (26–28). The scores range between 3 and 12 with higher scores indicating higher cancer worry levels. Scores were aggregated to the family level by calculating the average (norm) and standard deviation (discrepancy) within the family.

Demographic characteristics—Information on age, gender, race, and previous cancer diagnosis was obtained through baseline self-report assessment. Medical records were obtained to confirm cancer histories. Participants with an identified deleterious mutation were designated as “carriers” while those without were designated as “non-carriers.” These variables were used as covariates in the analyses. Race and number of participants in the family were included as family-level covariates.

Analyses

Hierarchical linear growth models were fitted to evaluate the change in depression score over three assessment points and to assess its associations with baseline as well as change in family relationships following receipt of genetic test results; the moderating effect of the trend in cancer worry within the family (norms and discrepancies) on these associations was also investigated. Using these models, the clustered nature of the data (repeated measurements within individual participants within families) was accounted for and variability between individuals as well as families was assessed. The time variable was centered around the 12-month assessment because final status was the primary interest. Both baseline and change scores of the three FES subscales (cohesion, expressiveness, conflict) at 6-months were considered independent variables. The moderating effects of cancer worry were evaluated by adding family-level norms (family means) and discrepancy (family standard deviations) variables. Because variables based on standard deviations tend to be skewed, log transformations of the discrepancy variables were used (29). All variables considered, along with covariates, were added to the model. The final model was derived by removing non-significant independent and moderating variables based on the results of Wald statistics at a Type I error rate of .05. Models were fitted using HLM 6.04 (30).

RESULTS

The average age of the sample was 39.77 ($SD = 14.75$), ranging from 18 to 83. Other participant characteristics are presented in Table 1. The average number of participants from each family was 7.42, ranging from 3 to 31. Small families primarily consisted of first degree relatives, while the large families include participants spanning up to 4 generations. Descriptive statistics of the CES-D scores, family relationship variables, and cancer worry norms and discrepancies are presented in Table 2.

Regression coefficients, standard errors, and Wald statistics for the final model are presented in Table 3. With respect to the final status of the CES-D scores, the results indicate that lower perceived family cohesion at baseline ($b = -1.57$) and a decrease in perceived cohesion at 6-months after receipt of the results ($b = -1.567$), were directly associated with a higher depression score at 12-months. Perceived family expressiveness and conflict were not directly associated with the final status of CES-D scores. Higher levels of family discrepancy in cancer worry at baseline ($b = 11.33$) was also directly associated with higher depression scores at 12-month. With respect to the rate of change in CES-D over a 12-month period, the family relationships variables were not directly associated with the outcome.

Family trends in cancer worry moderated the effect of change in family conflict at 6-month and CES-D scores. Figures 1 and 2 present these interactions by plotting the 25th and 75th percentile scores on cancer worry and change in family conflict. Plots were created within the HLM program. With respect to family norms in cancer worry (Figure 1), an *increase* in family

conflict was associated with lower CES-D at 12-months as well as with a higher rate of decrease in CES-D over 12 months among individuals from families with a higher average level of cancer worry. CES-D scores showed little change among those from families with lower average cancer worry. For family-level deviation from cancer worry norms (Figure 2), more discrepancies in worry within family were associated with higher final CES-D. An *increase* in family conflict was associated with a larger reduction in CES-D among individuals from families with less discrepancy in cancer worries. An *increase* in conflict was associated with little change in CES-D among those from families with greater discrepancy. A *decrease* in family conflict was associated with a larger reduction in CES-D among individuals from families with greater discrepancy from the cancer worry norm; while families with low variability in cancer worry scores exhibited little change in CES-D when conflict was *decreased*.

DISCUSSION

The results of this study suggest the relevance of familial characteristics such as social relationships and family trend in cancer worry on the psychological adjustment of individuals receiving genetic test results. A cohesive familial social environment and similar levels of cancer worry among family members appear to be beneficial for the psychological adaptation. The results also showed that when family members have different levels of cancer worry (greater family discrepancy), then a decrease in family conflict may have positive implications. This suggests opportunities for interventions for families with greater discrepancy in worry by implementing counseling strategies that focus on minimizing conflicts among family members.

The importance of considering familial social contexts on psychological adaptation among those affected by genetic conditions, as the findings of the current study support, has also been pointed out previously (31). However, genetic services are mostly provided on an individual basis. The findings suggest that inclusion of family members in the form of group counseling may help facilitate the psychological adjustment of test recipients. Use of internet-based group counseling to facilitate adaptation among family members of children with chronic conditions has been reported (32), providing a potentially feasible way to include family members. If a family-based approach is not practical, informing test recipients of the importance of positive family relationships and ways to enhance relationships during counseling may be beneficial. Providing additional training to genetic counselors in family counseling would support such efforts. Assessing the levels of cancer worry and patterns of family interactions among multiple family members both before and after individuals undergo genetic testing may allow for more informed and targeted approaches to counseling. For example, families that exhibit low and decreasing levels of cohesion would benefit from interventions to increase cohesive and supportive interactions. If families are identified to be at high risk for psychological distress (e.g., members report low levels of cohesion and hold diverse levels of cancer worry), referral to psychological services may be appropriate.

In families where members share high levels of cancer-related worry, an increase in family conflict at 6 months was associated with a decline in depression scores 12 months after the receipt of genetic test result. The reasons for this finding cannot be explained using our currently available data, and this finding needs to be replicated before it can inform interventions. Evidence suggests that open communication about genetic test results may facilitate the psychological well-being of the recipients (33). Communication about a common health threat among involved individuals is hypothesized to be the first step of the cooperative coping processes (34). While it may lead to a temporal increase in family conflict especially when members share high levels of cancer worries, it may exhibit a first step toward adaptation. This concept of ‘short-term pain, long-term gain’ has been reported in the marital relationships literature in which disagreement and anger exchange between couples was associated with

increase in marital satisfaction (35) because avoiding problems may be ultimately more destructive than trying to work out relationships (36). Future studies that evaluate communication frequency, quality, and content in the context of families with high levels of shared cancer worry, and how these communication qualities relate to family relationships and psychological adaptation will allow the evaluation of this potential mechanism.

In addition, more research is needed in understanding what family conflict means in the context of genetic testing. The family conflict scale used in the current study asked about general family styles in resolving disagreements (e.g., in our family, we believe you don't ever get anywhere by raising your voice, family members hardly ever lose their tempers, family members rarely become openly angry, family members often criticize each other). Items that ask specifically about the conflicts associated with reactions to genetic risk information would be useful. Factors within the context of genetic testing that may contribute to increase in family conflict such as feelings of guilt and sorrow, and family members' reactions to test results (e.g., irritability, confusion) have been identified (37). Understanding these situation specific factors would be an important step in understanding the underlying mechanisms through which changes in family relationships lead to changes in distress.

This study showed that the directions of associations between perceived family conflict and psychological outcome were not always consistent. Further study is needed to identify factors that determine the direction of change in family conflict as well as how such change influences the psychological well-being of family members. Awareness of the familial risk among members (1), coping strategies (i.e., reframing, seeking spiritual support), and experience in providing care to relatives (38) have been suggested as possible factors associated with changes in perceived family functioning. Knowledge about such association is critical in developing effective interventions that consider both intra- and inter-personal factors.

Limitations

A majority of the participants in this study were Caucasians who were well-educated. This limits the generalizability of the results to a larger population. Similarly, not all eligible family members participated in this study. The precise reasons for non-participation are not known; however, they may include fear of insurance discrimination, lack of trust or interest in genetic test results, psychological and emotional concerns, and poor family communication. These family members, especially those who chose not to participate, may have different health-related beliefs than those who participated. Future studies should consider obtaining information from family members who do not undergo genetic testing to allow a more comprehensive understanding of the impact of genetic testing on family systems and the role of these systems in influencing individual well-being.

Although the number of families included in this analysis is satisfactory for this particular model, this study is limited by small family sizes, which is a common limitation with family studies. Any replication of this study would benefit by increasing the sample of families to compensate for the lower sample size per family. On the other hand, some families considered in this study were large (a maximum of 31 participants from one family). Additional consideration should be given when evaluating family norms in large families as socially or geographically distant relatives may not interact enough to form shared norms. Future studies might also consider the possibility of non-linear growth patterns in the psychological outcome if more assessment time periods are available.

CONCLUSIONS

The findings of this study support our premise that interventions to influence family environment may help facilitate the psychological adaptation of persons undergoing genetic

testing. Efficacy studies are needed to evaluate such family-based approaches to the provision of genetic services. It is expected that genetic testing will become available for more diseases (39) and that the use of such information in health care settings will continue to increase. Researchers are increasingly becoming aware of the importance of the familial social environment to the health and well-being of genetic test recipients (33). Increased understanding about the role of family characteristics in the psychological adaptation of individuals undergoing genetic testing for Lynch syndrome can provide valuable insights to the future practice concerning more commonly occurring diseases.

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Figure 1. Interaction between change in family conflict and family norm in cancer worries.
 Notes: Solid lines represent increase in and dashed lines represent decrease in family conflict.
 Thick lines represent high levels of cancer worry norm within families.

Figure 2. Interaction between change in family conflict and family discrepancy in cancer worries.
 Notes: Solid lines represent increase in and dashed lines represent decrease in family conflict.
 Thick lines represent high levels of cancer worry discrepancy within families.

Table 1Participant characteristics ($N = 178$)

	Yes
Male	42.1%
Married	56.2%
Caucasian	94.9%
African American	2.2%
Graduate degree/training	24.1%
College degree	52.8%
High school diploma/some college or technical school	22.2%
Personal history of cancer	23.6%
Mutation carrier	46.1%

Note: Information on education is not available for 40% of the participants.

Table 2
Descriptive statistics for CES-D, family environment, and cancer worry variables

	Mean	sd	Min.	Max.
<i>CES-D scores</i>				
Baseline	9.73	8.51	0.00	41.00
6-month	7.90	8.65	0.00	43.00
12-month	6.82	9.49	0.00	47.00
<i>Family environment variables (FE)</i>				
Cohesion: baseline	7.33	1.90	0.00	9.00
Cohesion: change	0.74	1.88	-7.00	9.00
Expressiveness: baseline	5.76	1.91	1.00	9.00
Expressiveness: change	-0.03	1.94	-7.89	5.00
Conflict: baseline	2.33	2.17	0.00	9.00
Conflict: change	-0.43	1.56	-5.11	5.00
<i>Family-level variables</i>				
Cancer worries (CW)				
Family norm	4.54	0.73	3.20	5.67
Family discrepancy	1.49	0.74	0.41	3.26

Table 3Regression coefficient estimates, standard errors, and *t* Ratios of the final model

	Coefficient	se	t Ratio
Mean final status	4.106	1.766	2.325*
Cancer worry: family norm	-3.102	1.881	-1.649
Cancer worry: family discrepancy	11.331	5.354	2.116*
Family cohesion at baseline	-1.569	0.465	-3.376***
Family cohesion change	-1.559	0.293	-5.317***
Family conflict at baseline	0.206	0.389	0.529
Family conflict change	0.067	0.673	0.099
Cancer worry: family norm	-4.779	1.878	-2.545*
Cancer worry: family discrepancy	12.196	5.440	2.242*
Mean growth rate	-1.559	0.435	-3.584***
Cancer worry: family norm	-1.077	0.825	-1.305
Cancer worry: family discrepancy	1.297	3.342	0.388
Family conflict at baseline	-0.287	0.256	-1.123
Family conflict change	-0.128	0.357	-0.358
Cancer worry: family norm	-2.800	0.819	-3.418***
Cancer worry: family discrepancy	8.513	2.719	3.131**

*
 $p < .05$,**
 $p < .01$,***
 $p < .001$

Note: 1. Final model controls for: family size, race, age, gender, cancer history, and mutation carrier status. 2. Non-significant family conflict variables are retained in the model for final status as controls because they were indirectly associated with the outcome for the growth rate. Similarly, non-significant cancer worry variables (main effects) were retained because of their significant moderating effects on the associations between family conflict change and CES-D.