Developing Shared Appraisals of Diabetes Risk Through Family Health History Feedback: The Case of Mexican-Heritage Families

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Abstract

Background Collecting complete and accurate family health history is critical to preventing type 2 diabetes.

Purpose We seek to identify the optimal risk feedback approach that facilitates risk communication between parents and their adult children and helps them develop shared appraisals of family history of type 2 diabetes.

Methods In a sample of parent-adult child dyads from 125 Mexican-heritage families residing in Houston, Texas, we examine change in parent-child dyadic (dis)agreement with respect to their shared family health history from baseline to 10 months after receipt of risk feedback generated by Family Healthware. A 2×2 factorial design is applied to test how the recipient (one parent or all family members) and the content (risk assessment with or without behavioral recommendations) of the feedback affect (dis)agreement through interpersonal ties, particularly dyadic risk communication.

Results Providing risk assessment without behavioral recommendations to the parent, but not the adult child, shifts the dyads toward agreement (relative risk ratio [RRR]= 1.78, 95% confidence interval [CI] [1.18–2.67]), by activating reciprocal risk communication between parents and children (RRR =2.70, 95% CI [1.81–4.03]). Dyads with close interpersonal ties are more likely to shift toward agreement (RRR = 3.09, 95% CI [1.89–5.07]).

Conclusion Programs aimed at improving family health history knowledge and accuracy of reports should tailor risk feedback strategically for better intervention effect and leverage a network approach in disease prevention among at-risk minority and/or immigrant populations.

Trial Registration Number: NCT00469339.

Keywords Family health history • Risk communication • Mexican-Heritage families • Type 2 diabetes

Despite a recent decline in new cases, type 2 diabetes continues to be highly prevalent and causes great morbidity, disability, and mortality burden, especially among Mexican Americans, the largest and fastest growing ethnic minority in the USA [1–3]. National estimates report an age-adjusted prevalence rate of diagnosed diabetes of 13.9% for Mexican Americans, compared with only 7.6% for non-Hispanic whites [1]. Community-based studies suggest an even higher prevalence of over 18% for Mexican-heritage individuals, when undiagnosed cases are incorporated [4, 5]. Individuals of Hispanic origin are also more likely than their non-Hispanic white counterparts to experience severe and fatal complications associated with diabetes, such as lower extremity amputation [6], vision impairment [7], and end-stage renal failure [2].

Type 2 diabetes is a complex disease, likely resulting from the joint effect of genetic, socioenvironmental, and lifestyle risk factors [8]. In addition to age and genetic predisposition [9], behavioral factors such as being overweight or obese and lack of exercise are strong determinants of one's risk for developing diabetes [10–12]. The incidence of diabetes is also associated with a history

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of other chronic conditions, including high blood pressure, high cholesterol, heart disease, and stroke [13]. These risk factors tend to cluster within families, thereby making family health history a robust predictor of diabetes. Specifically, having a family history of at least two first-degree relatives affected by diabetes or one first-degree and two second-degree relatives affected increases an individual's risk for diabetes by five times, after controlling for age, sex, body mass index, and education [14]. Because family health history is inexpensive and convenient to collect and yet highly valuable for personalizing prevention and treatment efforts, we see increasingly broad use of this genomic tool in patient care and public health interventions, including risk evaluation, lifestyle management, and health promotion [15, 16]. For Mexican Americans in particular, family health history is found to be more informative in predicting diabetes risk than other biological risk factors such as body mass index [17]. Therefore, identifying individuals at increased risk based on their family history has the potential to prevent disease onset more effectively, by enabling early detection and intervention before one's weight becomes harmful.

In this paper, we test a family network-based intervention that could help address a major challenge in using family health history for complex disease prevention—reporting incompleteness and inaccuracies by individual patients [18]. During routine clinical visits, the collection of family health history is often suboptimal, with considerable missing information in patients' self-reports [19–21], likely because only about one-third of Americans have collected information about complex disease diagnosis from relatives for the purpose of creating a family history [22]. A handful of studies that have assessed family health history knowledge among individuals of Hispanic origin suggest that such knowledge is particularly lacking in this population [23–25]. Even when interviewed in-person with a standard three-generation pedigree, Mexican Americans tend to have high rates of “don't know” responses when asked about family history of complex diseases [24]. One potential explanation to this result is that younger Mexican-heritage individuals born in the USA have limited contact with relatives living in Mexico. Moreover, accuracy of family health history reports is lower in Hispanic, Spanish-speaking families compared with white families [26].

Interpersonal mechanisms, particularly dyadic communication among family members, are directly relevant to family health history knowledge. The family is a relational social system where everyday conversations can affect individual's knowledge and awareness of a health issue [27]. Whether a complete family health history can be accurately conveyed to health care providers is dependent on family members effectively communicating their own diagnoses as well as their knowledge about

family's history of disease. This process is best captured by dyadic-level shared appraisals of familial disease risk [28]. Individually reported family health history data are likely of better quality when two family members are both aware of and agree on common relatives' diabetes diagnoses. In contrast, when responses contradict each other or when one or both members of the dyads do not know their relatives' diagnosis, it would suggest a sub-optimal state of family health history knowledge and a need for intervention.

To activate the communication pathway, we use families as a point of intervention and risk feedback based on family health history to motivate influence. This is because health information of an individual (e.g., a parent) is inherently relevant and has implications for other members of the family (e.g., adult child), as biologically related family members share heredity and, often, a common social environment, both of which jointly contribute to one's risk for diabetes [8]. When provided with health information such as diagnoses or risk assessments, dyads that are close to each other may feel particularly motivated to communicate about their own diagnoses as well as their shared family history of the disease [29]. In turn, interaction and information exchange in dyads can translate into shared appraisals of disease risk when they actively engage in collecting and updating their family health history. At the same time, distant and conflictual dyadic relationships can create barriers and delays in effective risk communication [30]. Prior research evaluating intervention programs on the basis of family health history has reported a number of changes associated with the provision of tailored risk feedback, including modified risk perceptions [31–33], more engagement in healthy behaviors [34–36], and increase in self-reported health communication [37, 38]. However, relatively less is known regarding whether providing risk feedback encourages a more proactive collection and update of family health history through risk communication.

To identify the optimal risk feedback approach for Mexican-heritage families, we introduce different feedback stimuli into the family system. In their review, Elder et al. [39] emphasize that the setting (e.g., family, school, and clinics) and the message are key to designing and evaluating programs addressing health communication in the Hispanic/Latino community. Thus, we first contrast an individual-centered approach where one parent receives the feedback with a family-centered approach where all the members of the households receive such feedback. In primary care settings, risk feedback is usually given to a single individual. Drawing on the body of literature that has demonstrated the effectiveness of family-based interventions in Mexican-heritage individuals [34, 35, 40], we hypothesize that compared with the current standard of care, providing such feedback to multiple household members will more effectively encourage

them to share risk information with each other, thereby promoting dyadic-level shared appraisals of familial risk. Next, we consider how the content of the feedback affects shared appraisals because communicating genetic risk can be motivated by the desire to exchange information or the need to take actions in response to a shared problem [28]. Capitalizing on the information exchange motive, predisposing risk feedback provides individuals with only a family health history–based risk assessment. Enabling feedback provides both risk assessments and behavioral recommendations about risk-reducing strategies, emphasizing individuals' control over disease onset. We hypothesize that the predisposing feedback is more effective in promoting shared appraisals of family history because risk assessment is directly relevant to information exchange and the behavioral recommendations are more closely linked to the need for collective action.

How do members of Mexican-heritage families develop shared appraisals of familial risk for diabetes? To address this question, we use network methodologies and seek to characterize how a stimulus (risk feedback intervention) could potentially work through interpersonal mechanisms (dyadic risk communication) to influence the development of agreement about shared family health history on diabetes. In a sample of parent-adult child dyads from Mexican-heritage families, we examine change in dyadic (dis)agreement with respect to shared family history of diabetes between parents and their children, following receipt of family health history–based risk feedback generated by Centers for Disease Control and Prevention's Family Healthware™. To identify the optimal feedback condition, we apply a 2×2 factorial design to test how the recipient (one parent or all family members) and the content (risk assessments only vs. risk assessments and behavioral recommendations) of the feedback affect dyadic (dis)agreement between parents and their adult children.

Methods

Data and Sample

Data were drawn from a larger household-based study using familial risk information to identify optimal approaches for promoting health communication and behavioral changes in multigenerational Mexican American families residing in Houston, Texas [41]. In the current study, we included only parents aged 60 years or younger and their adult child(ren) (aged 18–40 years) from these households because previous research found that the adult child generation was often at risk and yet unaware of their family health history [24]. Individual demographic information, family network ties, and a standard family health history on diabetes and other complex diseases diagnoses in first- and second-degree

biological relatives were collected. Individually reported pedigrees within families were pooled together to capture instances where the parent and the adult child report on a common biological relative (e.g., mother/maternal grandmother, brother/paternal uncle). After listwise deleting missing values in study variables, our final analytic sample consisted of 2,175 informant dyad comparisons of shared family history on diabetes made by 234 parent-adult child dyads (comprising 222 parents and 131 adult children in 125 households). Although there was about 9% missing data introduced by listwise deletion, preliminary analysis did not suggest any patterning in these missing data by study variables. We therefore retained complete case analysis.

Design and Measures

Figure 1 presents an overview of the study design and measures. The baseline interview was conducted during in-home visits by a pair of bilingual interviewers. Two follow-up telephone interviews were conducted at 3 and 10 months post feedback, respectively (2 out of 162 households were lost to follow-up). The interviewers were blind to the feedback condition to which each household were assigned.

Following baseline interview, personalized risk feedback was generated using Family Healthware, which provided a pedigree, a risk assessment, and personalized behavioral recommendations. The risk assessment (predisposing feedback) was based on an algorithm using family history developed by Scheuner et al. [9]. Behavioral recommendations (enabling feedback) included recommendations for lifestyle management and preventive screening. Specifically, participants received messages about managing diet, exercise, smoking, and alcohol use, as well as those about assessing cholesterol, blood pressure, and blood glucose levels. Individual feedback packets were mailed to each participant.

While all the participants received their pedigree, participating households were randomized to one of four feedback conditions defined by a 2×2 factorial design. The first condition was related to the recipient of the supplementary feedback—it was either family-centered where all household members received it or individual-centered where one parent received it. In the current analysis that includes only parent-adult child dyads, feedback was provided to both the parent and the adult if the household was randomized into the family-centered condition. It was only provided to the parent when the household was randomized into the individual-centered condition. The second condition was related to the content of the supplementary feedback—it was either predisposing risk feedback where participants were provided with a personalized risk assessment based on their family history or predisposing plus enabling feedback

Fig. 1. Study design and key measures: Risk Assessment of Mexican Americans (RAMA), Houston, TX. Family health history = family health history; diabetes = type 2 diabetes.

where participants were provided with a risk assessment coupled with personalized behavioral recommendations. Thus, the four feedback conditions were: (a) one parent received risk assessment but no behavioral recommendations, (b) one parent received risk assessment and behavioral recommendations, (c) all family members received risk assessments but no behavioral recommendations, and (d) all family members received risk assessments and behavioral recommendations (reference category).

Our outcome variable is *Change in Parent-Child (dis) Agreement on Family Health History*. A standard family health history on first- and second-degree relatives was independently collected at both baseline (in-person interview) and 10-month follow-up (telephone interview) from each participant. The pedigrees were linked within each family to identify common family members on whom both the parent and the child reported. For example, a mother and her daughter could both report on whether the daughter's maternal grandmother had been diagnosed with diabetes as part of their family health history report. With respect to common relatives' diabetes status, both the parent and the child indicated "yes," "no," or "don't know." When both responded "yes" or "no," we coded the pattern as "agree." When the responses were mixed (one responded "yes" and the other responded "no") or when one responded "yes" or "no" and the other responded "don't know," the pattern was coded as "disagree/missing." When both indicate "don't know," the pattern was also coded as "disagree/missing," because consistently missing data were not true agreement. Four categories described change in dyadic (dis) agreement on shared family health history: (a) disagree/missing at baseline and 10-month follow-up (reference

category), (b) agree at baseline and 10-month follow-up, (c) agree at baseline to disagree/missing at 10-month follow-up, and (d) disagree/missing at baseline to agree at 10-month follow-up.

Three dyadic attributes were included as major explanatory variables. Based on the gender of the dyad, we noted *Dyad Type*: mother-daughter, mother-son, father-daughter, father-son (reference category). *Closeness* between parent and child was assessed at baseline, based on participants identifying "who is very close to you" (1 = close relationship, 0 = otherwise). For a given parent-child dyad, if both indicated being close to each other, such a tie was coded as reciprocal. If only one indicated being close to the other in the dyad, we coded the tie as asymmetrical. If neither indicated being close to the other participant in the dyad, we coded the tie as null and used it as the reference category. *Discuss Family Risk for Diabetes* was assessed at 3-month follow-up. This was also a dyadic attribute consisting of three categories—reciprocal, asymmetrical, or null (reference category)—to indicate patterns of risk communication among dyad members.

We included several individual and household attributes as covariates. Parents' and children's ages were measured in years. A dichotomized variable was created to indicate whether both the parent and the child had high-school education (=1, else=0). Place of birth for parent-child dyads was indicated by three dichotomized variables: both born in Mexico, only the parent born in Mexico, and neither the parent nor the child born in Mexico (reference category). We also noted the household's homeownership (=1, else=0), based on the parents' report.

Statistical Analysis

Because we hypothesized that the risk feedback affects dyadic-level agreement on shared family health history via the risk communication pathway, we estimated a generalized structural equation model: the first equation used feedback conditions, dyadic type, and closeness at baseline to predict discussing family risk for diabetes at 3-month follow-up and the second equation used all predictors in the first equation and discussing family risk for diabetes to predict change in (dis)agreement. A multinomial link was used since change in agreement on family health history and discussing familial risk were categorical. Both equations included individual (age, education, and place of birth) and household (home ownership) attributes as covariates. We used the Huber-White Sandwich estimator to account for clustering of dyadic comparisons within households.

Results

Descriptive statistics of individual-, dyadic- and household-level characteristics are presented in Table 1. The average age was 48.32 years for the parents and 22.34 years for the children. Most parents were born in Mexico and fewer had high-school education than their

children. The vast majority of the parents reported owning their home. Of all the 233 parent-child dyads, 36% were mother-daughter dyads, 19% were mother-son dyads, 27% were father-daughter dyads, and the remaining 18% were father-son dyads. At baseline, 44% of the dyads had reciprocal closeness ties, 41% had asymmetrical closeness ties, and 16% had no closeness ties. At 3-month follow-up, 45% of the dyads reported no risk communication, 36% had asymmetrical communication ties, and 19% had reciprocal communication ties.

As shown in Table 2, the 233 parent-child dyads made 2,175 informant dyad comparisons with respect to shared family health history of diabetes, more than half of which were in agreement at both baseline and the 10-month follow-up (53%). Twenty-one percent of the comparisons were in disagreement or contained missing information at baseline and shifted to agreement at 10-month follow-up. Despite the fact that they were in agreement at baseline, 10% of the comparisons shifted to disagreement/missing at 10-month follow-up. The remaining 16% were in disagreement or missing throughout the study. When stratified by feedback conditions, the greatest shift from disagreement/missing to agreement, 31%, was observed among households where only one parent received the risk assessment with no behavioral recommendations. For households receiving the other three intervention conditions, over 15% of the comparisons shifted from disagreement/missing to agreement.

Table 3 presents results from a multivariate analysis using dyadic attributes as major explanatory factors of the change in parent-child family health history (dis)agreement, controlling for parents' and children's age, education, and place of birth, as well as household-level homeownership. Equation 1 estimated the effects of predictors on reciprocal and asymmetrical discussion of family risk for diabetes. The reference category was no discussion between dyads. We reported relative risk ratios (RRRs) relative to this category along with 95% confidence intervals (95% CIs). Two feedback conditions were significantly associated with post-feedback discussion between parents and their children about family risk for diabetes: all family members received risk assessments without behavioral recommendations (for reciprocal discussion: $RRR = 2.86$, 95% CI [1.95–4.21]; for asymmetrical discussion: $RRR = 3.09$, 95% CI [2.26–4.23]) and one parent received risk assessment without recommendation (for reciprocal discussion: $RRR = 2.70$, 95% CI [1.81–4.03]; for asymmetrical discussion: $RRR = 1.74$, 95% CI [1.27–2.40]).

Equation 2 in Table 3 examined predictors of change in family health history (dis)agreement from baseline to follow-up. The reference category was disagreement at both baseline and 10-month follow-up. Each supplementary feedback condition affected change in family health

Table 1 Individual-, Dyadic-, and Household-Level Characteristics

Individual attributes (<i>n</i> = 353)	Parent (<i>n</i> = 222)	Child (<i>n</i> = 131)
Mean age (SD)	48.32 (6.46)	22.34 (4.55)
Female	55%	63%
≥ High school	27%	71%
Born in Mexico	86%	39%
Dyadic attributes (<i>n</i> = 234)		
Dyad type		
Mother-daughter	35%	
Mother-son	19%	
Father-daughter	27%	
Father-son	18%	
Closeness at baseline		
Reciprocal	44%	
Asymmetrical	41%	
Null	16%	
Discuss family risk for diabetes at 3 months		
Reciprocal	19%	
Asymmetrical	36%	
Null	44%	
Household attribute (<i>n</i> = 125)		
Own home	84%	

Table 2 Change in Change in Parent-Child (Dis)Agreement Regarding Family Health History of Type 2 Diabetes by Intervention Conditions

	<i>n</i>	Disagree/missing	Agree	Agree to disagree/missing	Disagree/missing to agree
One parent received risk assessment, no recommendation	32 households, 89 members, 552 informant dyad comparisons	17%	44%	8%	31%
One parent received risk assessment and recommendation	32 households, 90 members, 588 informant dyad comparisons	13%	62%	10%	15%
All received risk assessment, no recommendation	31 households, 89 members, 549 informant dyad comparisons	14%	53%	12%	21%
All received risk assessment and recommendation	30 households, 85 members, 486 informant dyad comparisons	18%	53%	10%	19%
Total	125 households, 353 members, 2,175 informant dyad comparisons	16%	53%	10%	21%

Differences between intervention conditions tested using chi-squared test: $\chi^2(9) = 65.45, p < .001$

history (dis)agreement differently. Individual-centered feedback with predisposing risk information significantly increased the chance of dyads shifting from disagreement/missing to agreement (RRR = 1.78, 95% CI [1.18–2.67]). Individual-centered feedback with predisposing plus enabling information increased the chance of the dyads staying in agreement (RRR = 1.57, 95% CI [1.09–2.26]) but did not help to shift the dyads toward agreement. Family-centered feedback—with or without enabling information—was not associated with change in family health history (dis)agreement. A key driver of the change in family health history (dis)agreement was risk communication. Reciprocal discussion of family risk for diabetes post feedback was associated with a greater chance of the dyads shifting from disagreement/missing to agreement (RRR = 1.80, 95% CI [1.14–2.82]) and a greater chance of the dyads staying in agreement (RRR = 1.51, 95% CI [1.01–2.27]).

Taken together, the results suggested that individual-centered feedback with predisposing feedback was most effective in helping dyads shift toward agreement, both directly and indirectly by activating risk communication. In addition, we also found that the relational factors were important to risk communication and the development of agreement on family health history. Discussion of familial risk for diabetes was more likely to occur among dyads with at least one female actor and those with close interpersonal ties. The dyads with close interpersonal ties were also more likely to develop or stay in agreement after receiving risk feedback.

Discussion

Previous studies have consistently shown that compared with a generic message, a personalized message based on one's family health history, is more effective in improving family health history knowledge [24], modifying risk

perceptions [31–33], increasing family communication [37, 38], and encouraging positive lifestyle changes such as more physical activity [34–36], more fruit and vegetable consumption [36], and more regular cholesterol screening [36]. Using a dyadic approach, we have sought to extend this line of inquiry by examining the interpersonal mechanisms that link personalized risk feedback based on family health history to shared appraisals of familial risk for diabetes, an element critical to the effective utilization of family health history for more targeted diabetes prevention in at-risk populations.

Overall, we observe a sizable shift from disagreement/missing to agreement between parents and their adult children across all households, irrespective of the recipient and the content of the risk feedback. This suggests that collecting family health history data from the participants may in itself increase awareness and encourage individuals to update their family health history. The optimal feedback condition for developing shared appraisals is providing one parent with only predisposing information (i.e., risk assessment without behavioral recommendations). Specifically, this feedback condition can stimulate discussion of familial diabetes risk in the parent-child dyad. If reciprocated, such discussion subsequently leads to a reconciliation of family health history knowledge in the dyad. It is associated with a twofold increase in the chance of dyads shifting from disagreement/missing to agreement. In contrast, relative to the reference feedback condition, providing risk assessments to all the members of the household does not affect change in family health history (dis)agreement. This condition can however activate risk communication between parents and children.

These results support our hypothesis that predisposing feedback is more closely associated with developing shared appraisals of family history than enabling feedback but is contrary to our hypothesis that a

Table 3 Generalized Structural Equation Model With Multinomial Link Predicting Change in Parent-Child (Dis)Agreement Regarding Family Health History of Type 2 Diabetes ($n = 2,175$)

Intervention condition	Equation 1. Discuss family risk for diabetes at 3 months (Reference: null)				Equation 2. Change in (dis)agreement from baseline to 10 months (Reference: disagree/N/A)			
	Asymmetrical		Agree		Agree to disagree/ missing		Disagree/missing to agree	
	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
One parent received risk assessment, no recommendation	2.70	[1.81–4.03]	1.74	[1.27–2.40]	0.79	[0.55–1.13]	0.83	[0.49–1.41]
One parent received risk assessment and recommendation	1.04	[0.69–1.57]	1.01	[0.76–1.36]	1.57	[1.09–2.26]	1.50	[0.90–2.51]
All received risk assessment, no recommendation	2.86	[1.95–4.21]	3.09	[2.26–4.23]	1.08	[0.75–1.56]	1.47	[0.90–2.42]
All received risk assessment and recommendation	Reference		Reference		Reference		Reference	
Dyad type								
Mother-daughter	7.37	[5.08–10.69]	4.26	[3.11–5.85]	2.77	[2.60–4.00]	1.97	[1.19–3.26]
Mother-son	1.91	[0.60–1.47]	1.60	[1.12–2.67]	1.73	[1.16–2.58]	1.34	[0.76–2.35]
Father-daughter	1.28	[0.84–1.96]	1.68	[1.21–2.33]	2.38	[1.63–3.46]	1.64	[0.96–1.62]
Father-son	Reference		Reference		Reference		Reference	
Closeness at baseline								
Reciprocal	9.93	[5.75–17.14]	3.85	[2.77–5.36]	1.50	[1.00–2.25]	1.08	[1.21–3.70]
Asymmetrical	2.67	[1.52–4.68]	2.35	[1.69–3.28]	1.12	[1.29–1.62]	0.75	[0.43–1.33]
Null	Reference		Reference		Reference		Reference	
Discuss family risk for diabetes at 3 months								
Reciprocal	–		–		1.51	[1.01–2.27]	1.48	[0.85–2.58]
Asymmetrical	–		–		1.25	[0.93–1.68]	1.06	[0.69–1.62]
Null	–		–		Reference		Reference	

Log pseudolikelihood = –4346.63; AIC = 8855.26; BIC = 9315.73.

Model controlled for parents' and children's age, education, and place of birth, as well as household-level home ownership (results not shown). Huber-White Sandwich estimator used to adjust for clustering of comparisons by dyads within households. Intercept omitted. Relative risk ratios and 95% confidence intervals (in brackets) reported. Statistically significant ($\alpha = 0.05$) effects were bolded.

family-centered approach providing all household members with feedback is more effective. Because the parent is the recipient of the supplementary feedback if the household is randomized into the individual-centered feedback condition, we speculate that risk communication is more effective for developing shared appraisals when the parent initiates the discussion, due to generational differences in family health history knowledge in Mexican-heritage individuals [23, 24]. On receipt of risk assessment, the parent may feel motivated to discuss this information with their adult child, especially if he/she is at increased risk because it likely means that his/her child is also at increased risk. When the discussion is reciprocated by the adult child, the child will likely compare his/her family health history report with the parent's and update this knowledge accordingly. Although many advocate for intervention programs to activate and leverage health communication in families [21, 23, 37–39], our findings suggest that the impact of family risk communication may vary by the recipient of the intervention. Programs aimed to improve family health history knowledge should engage foreign-born Mexican American parents as family historians to disseminate information to younger generations born in the USA because the parents are presumably more knowledgeable about their shared family history.

In support of our hypothesis, including behavioral recommendations as part of the supplementary feedback reduces the likelihood of risk communication between parents and children, relative to other feedback conditions. One possible explanation to this pattern is that risk assessments may be perceived as information and behavioral recommendations as expert opinions or guidelines. When risk-reducing recommendations are presented along with the risk assessments, participants may focus more on “what we should do” than “what we don't know.” Indeed, we see in a previous research that providing behavioral recommendations is associated with more coencouragement of physical activity between parents and children [34]. While behavioral modification is a desirable outcome in health promotion, a complete family history on complex diseases collected by individuals has broad implications in clinical care, ranging from determining treatment options when other risk factors yield uncertainty [42] to aiding the interpretation of genetic test results [19]. Therefore, intervention programs aimed to encourage family members to exchange and update their shared family history are important and such efforts may benefit from providing family members with predisposing risk feedback.

Consistent with the literature [28–30], our results highlight the importance of relational factors in health communication and disease prevention. Dyads with at least one female actor are more likely to communicate about risk. Furthermore, dyads with close interpersonal ties are

more likely to communicate and shift toward agreement on shared family health history. These are largely consistent with prior research examining family functioning and genetic testing in the context of hereditary cancer syndromes [29], suggesting that engaging a female family leader who is already in close, supportive relationships within others is key to activate pathways and motivate influence across disease context with varied genetic etiologies. One surprising finding is that mother-daughter dyads and those with reciprocated closeness ties are also more likely to shift from agreement to disagreement/missing. Previous literature has suggested that one barrier to active collection/update of family health history is fear of interpersonal conflict [30], which is orthogonal to closeness [43]. It is plausible that risk communication does not necessarily lead to reconciliation of discrepancies even in close relationships because they can also be of high conflict. Future research should further characterize interpersonal ties and consider how they may influence health-related knowledge and behaviors.

The most significant strength of our study is its dyadic approach. We have demonstrated that disease risk often viewed as individual in nature can instead be better understood as a shared experience [28, 29]. A dyadic examination reveals discrepancies in family health history knowledge between members of the same family, which is typically obscured in studies using individual-level data. Although such discrepancies can be implied by age and generational differences in family health history knowledge [23, 24], we elicit more specific information about shared appraisals of family health history and provide mechanistic insights. Our dyadic analysis also represents a framework where discrepancy in family health history knowledge does not need to be treated as error and discounted. Rather, we endorse future research and intervention designs for collecting and analyzing family health history data that embrace discrepancies as an important source of heterogeneity and signals of interpersonal dynamics in families [44].

At the same time, our study has two limitations. First, our recruitment is limited to Mexican-heritage families in Houston, Texas. The sample is more representative of a particular type of dyads where the parent was born in Mexico with less education and the adult child was born in the USA and had higher educational attainment. This sample is also relatively homogeneous with respect to socioeconomic status with most of the households owning their home. While the pathways and mechanisms examined in the current study are broadly conceived and potentially generalizable to families in other geographic areas and of different structures, more research based on other sampling and recruitment strategies in different geographic area is needed to replicate our findings. Second, because of lack of available medical records, we assume that the family health history data are of better

quality when the dyad is in agreement with respect to a common family member's disease diagnoses. It is possible that the data are still inaccurate even if the parent and the child agree. Therefore, future research should investigate the robustness of these findings using additional validation criteria.

Conclusions

Capitalizing on network methodologies, we have leveraged a rich relational data set to explore the interpersonal mechanisms underlying the development of shared appraisals of family health history in Mexican-heritage families. Our findings suggest that interpersonal ties play a significant role in determining the conditions under which members of these families, especially the younger generation, will update their family health history information. Researchers should tailor risk feedback strategically for more optimal diffusion of family health history knowledge.

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Compliance with Ethical Standards

Authors' Statement of Conflict of Interest and Adherence to Ethical Standards The authors have no conflict of interest to report.

Author Contributions J.L., C.S.M., A.V.W. and L.M.K. conceived the study. J.L. analyzed data, interpreted the results and wrote the article with input from all authors. C.S.M. contributed to the interpretation of results. A.V.W. supervised data collection. L.M.K. developed the theoretical framework.

Primary Data The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Department of Health and Human Services or the U.S. Government. This work is original, has not been published elsewhere, is not presently under consideration by any other journal. Portions of the findings were presented at the 2016 Annual Meeting of the Society of Behavioral Medicine in Washington DC. The manuscript does not contain materials copied from anyone else. The authors have full control of all primary data and that they agree to allow the journal to review their data if requested.

Ethical Approval The IRBs of National Human Genome Research Institute (07-HG-N140) and University of Texas MD Anderson Cancer Center approved the study.

Informed Consent Written and verbal consent were obtained prior to study participation.

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