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Sharing and seeking information about skin cancer risk and prevention among Hispanic people from Florida and Puerto Rico

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ABSTRACT

Objective: To explore factors associated with communication and information-seeking after receipt of skin cancer prevention information among Hispanic individuals.
Methods: Multivariable logistic regression was used to analyze existing data on demographics, personal experience, salience, and beliefs variables collected from Hispanic individuals to determine independent associations with sharing and seeking information about skin cancer prevention.
Results: Of 578 participants, 53% reported any communication about skin cancer prevention behaviors or skin cancer genetic risk; and 31% and 21% sought additional information about preventive behaviors or genetic risk, respectively. Female sex, greater perceived severity, higher comparative chance of getting skin cancer, and lower health literacy were associated with greater communication, while having no idea of one's own skin cancer risk was related to less communication. Greater health numeracy and higher cancer worry were associated with information-seeking about prevention behaviors and genetic risk.
Conclusion: Up to half of participants reported communication or information-seeking, although factors associated with specific activities differed. Future studies should evaluate how to promote communication behaviors in the Hispanic community and how sharing and seeking information influence an individual's network prevention practices.
Innovation: Several factors related to communication behaviors among Hispanic people after obtaining skin cancer prevention information were identified.
Trial registration: This trial was registered on clinicaltrials.gov (NCT03509467).

1. Introduction

Skin cancer is the most common type of cancer [1]. The incidence of melanoma among Hispanic people has increased an average of 0.5% annually between 2000 and 2019 [2]. Rates of basal cell carcinoma and squamous cell carcinoma also have increased among Hispanic people [3]; in Puerto Rico, these two skin cancers increased 300% between 1974 and 2005 [4]. Compared to non-Hispanic White people, Hispanic people suffer from skin cancer disparities, resulting in increased morbidity and mortality [3,5-7].

Hispanic people have lower perception of risk for skin cancer [8] and are less likely to talk about skin cancer risk with family members [9]. As Hispanic people become more English language-acculturated, they report a decline in sun-safe behaviors such as using sunscreen and wearing protective clothing [10,11]. Communication about health topics, including skin cancer, is related to engaging in recommended health behaviors at the individual [12,13] and couple level [13,14], and thus is an important strategy for promoting recommended behaviors. Factors associated with information sharing and information seeking about skin cancer prevention include higher coping and threat appraisal [9,10,15], cancer worry [16], perceived shared cancer risk [17], burnability [9], higher health literacy [9], higher income [9], greater

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education [9,18], female sex [15,18] and younger age [15]. Although communication about skin cancer can function as a catalyst for awareness and engagement in preventive behaviors, little is known about skin cancer communication among Hispanic people.

Cultural factors such fatalism and familism are relevant to the Hispanic community and might be associated with communication behaviors [19]. Cancer fatalism is the belief that cancer cannot be prevented and that a diagnosis with cancer will inevitably lead to death. Cancer fatalism is inversely related to information-seeking about cancer [20,21]. Familism is a cultural value that prioritizes the obligation, loyalty, support, and interconnectedness within family members [22]. Familism is associated with family communication among Hispanic adolescents [23]. Little is known about how these cultural factors relate to individuals' communication behaviors about skin cancer risk and prevention behaviors within family and social networks.

We recently completed a skin cancer precision prevention trial among Hispanic participants [24]. The intervention, provision of genetic test results and skin cancer prevention information, was grounded in Protection Motivation Theory (PMT), which posits that threat appraisal (perceived risk and severity) and coping appraisal (response and self-efficacy) influence health behaviors [25]. Using data from this trial, we conducted secondary analyses to identify (i) factors associated with information-sharing about skin cancer prevention, (ii) recipient-specific factors associated with information-sharing about skin cancer prevention, and (iii) factors associated with information-seeking about skin cancer prevention. To do so, we use the Comprehensive Model of Information Seeking (CMIS), which identifies salience (e.g., perceived risk, severity, cancer worry), beliefs (e.g., self-efficacy), in addition to demographics (e.g., gender, age, education), and personal experience (e.g., family history of cancer, familism) as antecedent constructs that motivate information-seeking [26]. Because information-sharing and information-seeking are related communication activities influenced by similar factors [27], we evaluated associations of CMIS antecedents and PMT constructs with both sharing and seeking information about skin cancer prevention participants.

2. Methods

2.1. Participants and setting

We conducted secondary analyses of data collected in a previously published randomized controlled precision prevention trial to improve skin cancer preventive behaviors in a Hispanic population [24]. Briefly, between September 2018 and January 2020, self-identified Hispanic adults were recruited from eight primary care clinics and community health centers in Tampa, Florida (FL; at least 18 years old, corresponding to age of majority) and Ponce, Puerto Rico (PR; at least 21 years old, corresponding to age of majority). Individuals who had a full body skin examination within the past year, a previous diagnosis of melanoma, or more than one diagnoses of basal and/or squamous cell carcinoma were excluded from this study. All participants gave written informed consent. The Institutional Review Boards of the University of South Florida, (Pro00020044, approved August 30, 2018), Ponce Health Sciences University (170807-BS, approved December 6, 2017), and the Comité de Seguimiento de la Investigación Clínica at Hospital Damas (HD 19–17, approved December 18, 2017) approved study procedures.

DNA isolated from saliva kits was used to fully genotype the coding sequence of the melanoncortin-1 receptor (*MC1R*) gene. Participants were randomized to receive precision skin cancer prevention materials (*MC1R* genetic risk and genetics-based prevention guidelines) or standard skin cancer prevention materials (non-genetics-based). At the end of the study, participants on the standard arm were provided with precision prevention materials. All participants completed a baseline assessment, and 80% completed a supplemental baseline questionnaire that measured familism and fatalism. Participants were followed over time and asked to complete a 3- and 9-month follow-up assessment. Outcomes of interest for the parent efficacy trial included primary and secondary skin cancer prevention activities, which were measured across the three time points. Participants were given the option to receive either English- or Spanish-language study materials, and Spanish-speaking Hispanic research staff were available to engage with participants.

2.2. Measures

Sociodemographic characteristics. Age, sex, marital status, race, Hispanic identity, education, health literacy, and health numeracy were collected at baseline. Health literacy was measured by a 3-item scale that ranged from 1 to 5, with higher scores indicating greater health literacy ($\alpha = 0.71$) [28]. Health numeracy was measured by the question "In general, how easy or hard do you find it to understand medical statistics?" (range "very easy" = 1 to "very hard" = 4) [29].

Experience variables. Study location identifies location of participant recruitment (Tampa, Florida or Ponce, Puerto Rico). At baseline, participants reported on family history of cancer, including history of skin cancer (melanoma, squamous cell carcinoma, and basal cell carcinoma) and other cancers. We created a dichotomous variable based on responses to a modified single-item version of the Control Preference Scale to indicate family involvement in health decision making or not ("I make my own decisions"=0 vs "I make decisions after hearing my family's opinion"=1, "My family and I make decisions together"=1, "My family makes the final decision after talking to me and hearing my opinion"=1, "I leave decisions to my family"=1) [30]. Familism was measured using the 18-item Attitudinal Familism Scale [31]; average scores were calculated with higher scores indicating higher levels of familism (range 1 to 4; $\alpha = 0.86$). Fatalism was measured with the 15-item Powe Fatalism Inventory [32], which consists of dichotomous items "agree" = 1 or "disagree" = 0. Participants' higher scores indicated higher levels of cancer fatalism (range 0 to 15; $\alpha = 0.79$).

Salience variables. Perceived severity, perceived risk, and cancer worry were measured at three months post-intervention. Perceived severity was measured using a 7-item 4-point Likert-type scale adapted from previous research (e.g., "I consider skin cancer to be life-threatening disease") [33]; scores were averaged and higher scores indicated higher perceived severity (range 1 to 4; $\alpha = 0.54$). To assess perceived risk, participants were asked to rate their absolute chance to develop melanoma during their lifetime (likely/unlikely) and their comparative chance to develop melanoma relative to other persons of similar age and gender (1 = well below average to 5 = well above average) [33,34]. A 3-item adaptation of the Lerman's Cancer Worry scale was used to measure skin cancer worry [35,36]. Participants' average scores were calculated, where higher scores indicated greater cancer worry (range 1 to 5; $\alpha = 0.73$).

Beliefs. Response efficacy and self-efficacy for skin cancer prevention were measured at three months post-intervention. Seven behaviors to reduce skin cancer risk were assessed (e.g., limiting sun exposure between 10 am to 4 pm, wearing long-sleeved shirts). Response efficacy was measured by participants' perception on how important each behavior was to reduce skin cancer risk, and self-efficacy identified participants' perception on how capable they were to perform these activities [37]. The 7-item 4-point Likert-type scales were averaged, and higher scores indicated higher levels for each construct (Cronbach $\alpha =$ 0.88 and 0.81, respectively).

Information-sharing and information-seeking. At three and nine months post-intervention, participants were asked if they communicated about prevention behaviors for skin cancer (yes/no) [for participants who received standard prevention information] or about genetic test results or prevention behaviors for skin cancer (yes/no) [for participants who received precision prevention information] and with whom (spouse, family, friends, healthcare providers) [37]. Participants also reported whether they sought additional information about prevention behaviors and/or genetic testing. Participants' who endorsed communication

either at three or nine months were coded as having communication and by topic and recipient of communication. Similarly, participants' who reported information seeking at three or nine months were classified as seeking additional information by topic.

Study arm. For the current analyses, the higher-risk group consisted of participants at *MC1R* higher risk who received precision prevention information, and the average-risk group consisted of those at *MC1R* average risk who received precision prevention information. Participants who received standard information, regardless of their *MC1R* risk, were categorized as the standard group.

2.3. Statistical analysis

Chi-square and ANOVA F-tests were used to examine differences in sociodemographic characteristics by participant's study arm. Univariate logistic regression analyses were conducted to explore predictors of communication about both prevention behaviors and genetic testing, and each of these separately; and separately by recipient (spouse, family, friends, and health care providers); as well as predictors of information-seeking about prevention behaviors or about genetic testing for skin cancers. Demographic characteristics, experience, salience, and beliefs variables were evaluated as possible predictors for each communication and information-seeking outcomes. Due to small numbers, we collapsed race into White and other, and Hispanic identity to Puerto Rican and other. Variables with p-value ≤ 0.2 in univariate models were included in multivariable logistic regression models that incorporated backward stepwise selection based on Akaike Information Criterion (AIC) [38], which selects variables based on overall model fit instead of each variables' statistical significance to obtain a parsimonious set of factors for each final models. All final models included adjustment for participant study arm or genetic risk group. Analyses were conducted using R software (ver 4.1.0, R Foundation for Statistical Computing, Vienna, Austria, RRID:SCR_001905) and RStudio (ver 1.4.1717, RStudio Team, Boston, MA, RRID:SCR_000432).

3. Results

3.1. Participant characteristics

This study analyzed 578 participants who completed the baseline assessment and at least one follow-up assessment. The mean participant age was 47 years (SD = 15.2), and the majority were female (75%), had at least some college education (74%), and self-identified as White (80%) and as Puerto Rican (69%). One-half were married or had a domestic partner (56%), preferred Spanish language materials (57%), and were recruited in Tampa (52%). Apart from comparative and absolute chance of getting melanoma at three months post-intervention, no significant differences in participant characteristics were found across the three groups (standard, average risk, higher risk) defined by study arm and genetic risk category (Table 1). Participants in the higher risk group reported a higher comparative chance of getting skin cancer ($p < 0.001$) and more often reported they were likely to get skin cancer ($p < 0.01$) compared to participants in the average risk and standard groups.

3.2. Factors associated with information-sharing about skin cancer prevention

Forty-four percent of participants reported communication about preventive behaviors and 42% reporting communication about genetic results and testing (Table 1). Fifty-three percent reported communication of any kind. Participants in the standard arm reported more communication about preventive behaviors than participants in either the precision prevention average or higher risk arms ($p < 0.001$). Univariate associations of demographic characteristics, experience, salience, and beliefs variables with communication about skin cancer prevention and genetic risk of skin cancer are provided in Supplemental

Table 1
Participant characteristics, communication, and information-seeking* by study arm and genetic risk category.

Variables	Standard arm	Precision prevention arm			Total
	$n = 288$ n (%)[a]	Average risk $n = 114$ n (%)	Higher risk $n = 176$ n (%)	p-value[b]	$n = 578$ n (%)
Demographics					
Age (mean, SD)	46.8 (15.5)	47.1 (14.4)	46.3 (15.3)	0.90	46.7 (15.2)
Female	219 (77)	81 (72)	129 (74)	0.54	429 (75)
Marital status				0.79	
Single or never married	76 (27)	27 (24)	44 (25)		147 (26)
Married, domestic partnership, or civil union	152 (53)	67 (59)	100 (58)		319 (56)
Divorced, separated, or widowed	58 (20)	19 (17)	30 (17)		107 (19)
Highest degree				0.64	
Graduate degree or higher	49 (17)	17 (15)	33 (19)		99 (17)
Four-year college degree	87 (31)	39 (35)	46 (27)		172 (30)
Some college	71 (25)	34 (30)	45 (26)		150 (27)
High school or GED	37 (13)	13 (12)	26 (15)		76 (13)
Less than high school or GED	40 (14)	9 (8)	21 (12)		70 (12)
Prefers Spanish-language materials	175 (61)	58 (51)	99 (56)	0.18	332 (57)
Health literacy (mean, SD)	4.4 (0.7)	4.6 (0.5)	4.43 (0.7)	0.09	4.4 (0.7)
Health numeracy (mean, SD)	3.0 (0.7)	3.07 (0.7)	3.08 (0.8)	0.80	3.1 (0.7)
Race				0.32	
White	235 (82)	86 (75)	144 (82)		465 (80)
Other	53 (18)	28 (25)	32 (18)		113 (20)
Hispanic identity				0.12	
Puerto Rican	204 (71)	75 (66)	119 (68)		398 (69)
Central/South American but not Brazilian	34 (12)	11 (10)	24 (14)		69 (12)
Cuban	17 (6)	12 (11)	12 (7)		41 (7)
Mexican	19 (7)	2 (2)	12 (7)		33 (6)
Mixed (more than one selected)	6 (2)	6 (6)	4 (2)		16 (3)
Other	8 (3)	8 (7)	5 (3)		21 (4)
Experience					
Study location					
Puerto Rico	141 (49)	48 (42)	86 (49)	0.43	275 (48)
Family history of cancer	171 (60)	73 (65)	112 (64)	0.51	356 (62)
Health decision preference					
I make my own decisions	185 (64)	73 (64)	113 (64)	0.99	371 (64)
Familism (mean, SD)	3.1 (0.4)	3.1 (0.4)	3.0 (0.4)	0.29	3.1 (0.4)
Salience at 3 months					
Perceived severity (mean, SD)	2.8 (0.4)	2.8 (0.4)	2.7 (0.4)	0.15	2.8 (0.4)
Perceived risk					
Absolute chance of getting skin cancer				<0.01	

(*continued on next page*)

Table 1 (*continued*)

Variables	Standard arm	Precision prevention arm			Total
	$n = 288$ n (%)[a]	Average risk $n = 114$ n (%)	Higher risk $n = 176$ n (%)	p-value[b]	$n = 578$ n (%)
Unlikely	79 (34)	38 (40)	34 (23)		151 (32)
No idea	101 (44)	40 (42)	66 (44)		207 (43)
Likely	52 (22)	17 (18)	51 (34)		120 (25)
Comparative chance of getting skin cancer (mean, SD)	2.4 (1.0)	2.3 (0.9)	2.8 (1.0)	<0.001	2.5 (1.0)
Cancer worry scale (mean, SD)	2.0 (0.8)	1.9 (0.8)	2.0 (0.9)	0.57	2.0 (0.8)
					Beliefs
Fatalism (mean, SD)	3.2 (2.8)	3.0 (2.9)	3.1 (2.7)	0.84	3.1 (2.8)
Response efficacy at 3 months (mean, SD)	3.5 (0.05)	3.5 (0.6)	3.5 (0.6)	0.97	3.5 (0.6)
Self-efficacy at 3 months (mean, SD)	3.5 (0.5)	3.5 (0.5)	3.5 (0.5)	0.36	3.5 (0.5)
Information sharing at 3 or 9 months					
Any communication	161 (56.3)	51 (45.5)	90 (52.0)	0.15	302 (52.9)
Communication about preventive behaviors	148 (52)	35 (32)	66 (38)	<0.001	249 (44)
Communication about genetic risk[c]	N/A	44 (40)	74 (43)	0.62	118 (42)
Recipient of communication					
Any relative	110 (39)	19 (17)	54 (31)	<0.001	183 (32)
Spouse/partner[d]	72 (48)	29 (45)	41 (42)	0.67	142 (46)
Friend	64 (22)	15 (14)	37 (22)	0.13	116 (20)
Healthcare provider	18 (6)	9 (8)	16 (9)	0.49	43 (8)
Information seeking at 3 or 9 months					
Information seeking about preventive behaviors	88 (32)	27 (24)	61 (35)	0.11	176 (31)
Information seeking about genetic testing[c]	N/A	21 (18)	38 (22)	0.45	59 (21)

[*] Unless otherwise specific, measures were collected at baseline.
[a] Values are N (%) unless otherwise noted.
[b] Group differences were evaluated using chi-square and ANOVA tests.
[c] Only includes participants in the precision prevention group who completed a follow-up assessment ($n = 290$).
[d] Only includes participants with a domestic partner or married at baseline who completed a follow-up assessment ($n = 312$).

Table 1.

Independent factors associated with more communication of any kind included female sex (OR = 1.77; 95% CI = 1.12–2.84), higher perceived severity (OR per unit increase = 2.34; 95% CI = 1.45–3.84), and higher comparative chance of developing skin cancer (OR per unit increase = 1.42; 95% CI = 1.13–1.78) (Table 2). Higher health literacy (OR per unit increase = 0.72; 95% CI = 0.51–0.99) and having no idea of one's absolute chance of developing skin cancer (vs. unlikely chance; OR = 0.51; 95% CI = 0.31–0.81) were associated with less communication of any kind.

Similarly, higher perceived severity (OR per unit increase = 3.02; 95% CI = 1.83–5.08) and higher comparative chance of developing skin cancer (OR per category increase = 1.57; 95% CI = 1.24–2.02) were independently associated with more communication specifically about prevention behaviors, and having no idea of one's absolute chance of developing skin cancer (vs. unlikely chance; OR = 0.47; 95% CI = 0.29–0.77) was associated with less communication (Table 2). Higher cancer worry (OR per unit increase = 1.32; 95% CI = 1.01–1.73) and higher response efficacy (OR per unit increase = 1.75; 95% CI = 1.18–3.65) also were associated with greater communication about prevention behaviors.

Independent factors associated with more communication specifically about genetic risk included female sex (OR = 2.36; 95% CI = 1.23–4.75), higher perceived severity (OR per unit increase = 2.65; 95% CI = 1.34–5.40), higher comparative chance of developing skin cancer (OR per unit increase = 1.48; 95% CI = 1.08–2.05), and being married, in a domestic partnership, or civil union (vs. single, divorced, widowed; OR = 2.04; 95% CI = 1.13–3.58) (Table 2). Older age (OR per year increase = 0.98; 95% CI = 0.96–1.00) was associated with less communication about genetic risk.

3.3. *Recipient-specific factors associated with information-sharing about skin cancer prevention*

One-third (32%) of participants reported communication with a relative, 20% with a friend, and 8% with a healthcare provider. Among participants in a relationship ($n = 312$), 46% reported communication with their partner. There was a statistically significant difference in communication with relatives ($p < 0.001$) across participants; those in the standard arm were most likely to communicate with a relative (56%) compared to those at average risk (17%) and those at higher risk (31%). Univariate associations of demographic characteristics, experience, salience, and beliefs variables with communication with others are provided in Supplemental Table 2.

Female sex (OR = 2.07; 95% CI = 1.21–3.63), family involvement in health decisions (vs. preference in making health decisions without family; OR = 1.67; 95% CI = 1.06–2.64), higher perceived severity (OR per unit increase = 1.90; 95% CI = 1.15–3.18), higher comparative chance of developing skin cancer (OR per unit increase = 1.44; 95% CI = 1.14–1.82) and higher response efficacy (OR per unit increase = 1.58; 95% CI = 1.04–2.49) were independently associated with communication with a relative (Table 3). Higher perceived severity (OR per unit increase = 1.75; 95% CI = 1.00–3.08), higher comparative chance of developing skin cancer (OR per unit increase = 1.58; 95% CI = 1.22–2.06) and higher response efficacy (OR per unit increase = 2.09; 95% CI = 1.15–4.03) also were associated with communication with friends.

Similarly, independent factors associated with communication with health care providers included higher perceived severity (OR per unit increase =2.27; 95% CI = 1.01–5.21) and higher comparative chance of developing skin cancer (OR per unit increase = 2.12; 95% CI = 1.42–3.30), but also included age (OR per unit increase = 1.03; 95% CI = 1.01–1.06) and family involvement in health decisions (vs. preference in making health decisions without family; OR = 2.06; 95% CI = 1.02–4.20).

Among those who were married or had a domestic partner at baseline, factors associated with more communication with a spouse/partner were higher health numeracy (OR per unit increase = 1.59; 95% CI = 1.01–2.55) and higher perceived severity (OR per unit increase = 2.91; 95% CI = 1.53–5.73), while higher health literacy (OR per unit increase = 0.62; 95% CI = 0.39–0.96) was associated with less communication.

3.4. *Factors associated with information-seeking about skin cancer prevention*

Thirty-one percent sought additional information about skin cancer prevention, and 21% of participants in the precision prevention group sought additional information about genetic testing (Table 1). Results from univariate analyses of information-seeking with demographic

Table 2
Multivariate logistic regression models examining communication about prevention behaviors and genetic risk.[a]

Predictors	Any communication		Prevention behaviors		Genetic risk	
	$n = 462$		$n = 460$		$n = 233$	
	OR	95% CI	OR	95% CI	OR	95% CI
Demographics						
Age (years)	–	–	–	–	**0.98**	**0.96–1.00**
Female (ref.: male)	**1.77**	**1.12–2.84**	–	–	**2.36**	**1.23–4.75**
Married/domestic partnership (ref.: single, divorced and widowed)	–	–	–	–	**2.04**	**1.13–3.58**
Health literacy	**0.72**	**0.51–0.99**	–	–	–	–
Experience						
Family is involved health decisions (ref.: Makes health decisions without family)	1.45	0.94–2.24	1.35	0.88–2.07		
Salience						
Perceived severity	**2.34**	**1.45–3.84**	**3.02**	**1.83–5.08**	**2.65**	**1.34–5.40**
Perceived risk						
Absolute chance of getting skin cancer						
No idea (ref.: unlikely)	**0.51**	**0.31–0.81**	**0.47**	**0.29–0.77**	–	–
Likely (ref.: unlikely)	0.61	0.33–1.14	0.60	0.32–1.11	–	–
Comparative chance of getting skin cancer	**1.42**	**1.13–1.78**	**1.57**	**1.24–2.02**	**1.48**	**1.08–2.05**
Cancer worry	–	–	**1.32**	**1.01–1.73**	–	–
Beliefs						
Response efficacy	1.43	0.99–2.07	**1.75**	**1.18–3.65**	–	–
Study arm or genetic risk						
Average risk (ref. standard risk)	0.65	0.39–1.08	**0.36**	**0.21–0.62**		
Higher risk (ref. standard risk)	0.73	0.46–1.17	**0.45**	**0.28–0.73**		
Higher risk (ref. average risk)					0.87	0.48–1.60

Bolded values indicate statistically significant findings from the AIC models.
[a] All models were adjusted for study arm or genetic risk category.

Table 3
Results from multivariate logistic regression models examining communication about prevention behaviors by recipient.[a]

Predictors	Relatives		Friend		Spouse/partner		Healthcare provider	
	$n = 441$		$n = 463$		$n = 254$		$n = 468$	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Demographics								
Age (years)	–	–	–	–	–	–	**1.03**	**1.01–1.06**
Female (ref.: male)	**2.07**	**1.21–3.63**	–	–	1.54	0.86–2.78	–	–
Married/domestic partnership (ref.: single, divorced and widow)	–	–	0.65	0.40–1.04	**–**	**–**	–	–
Puerto Rican (ref.: other)	–	–	–	–	0.58	0.33–1.01	–	–
Health literacy	–	–	–	–	**0.62**	**0.39–0.96**	–	–
Health numeracy	1.24	0.92–1.68	1.37	0.97–1.95	**1.59**	**1.01–2.55**	–	–
Experience								
Family is involved health decisions (ref.: Makes health decisions without family)	**1.67**	**1.06–2.64**	–	–	–	–	**2.06**	**1.02–4.20**
Familism	0.74	0.42–1.28	–	–	–	–	–	–
Salience								
Perceived severity	**1.90**	**1.15–3.18**	**1.75**	**1.00–3.08**	**2.91**	**1.53–5.73**	**2.27**	**1.01–5.21**
Perceived risk								
Absolute chance of getting skin cancer								
No idea (ref.: unlikely)	–	–	0.57	0.28–1.09	0.49	0.25–0.94	–	–
Likely (ref.: unlikely)	–	–	0.63	0.36–1.09	0.39	0.16–0.95	–	–
Comparative chance of getting skin cancer	**1.44**	**1.14–1.82**	**1.58**	**1.22–2.06**	1.33	0.97–1.85	**2.12**	**1.42–3.30**
Beliefs								
Response efficacy	**1.58**	**1.04–2.49**	**2.09**	**1.15–4.03**	1.74	1.00–3.14	–	–
Self-efficacy	**–**	–	1.70	0.85–3.49	–	–	–	–
Study arm								
Average risk (ref. standard risk)	0.29	0.15–0.54	0.57	0.28–1.09	0.96	0.47–1.93	1.78	0.69–4.39
Higher risk (ref. standard risk)	0.49	0.30–0.80	0.63	0.36–1.09	0.67	0.35–1.27	1.15	0.50–2.61

Bolded values indicate statistically significant findings from the AIC models.
[a] All models were adjusted for study arm.

characteristics, experience, salience, and beliefs variables are provided in Supplemental Table 3.

Independent factors associated with seeking additional information about preventive behaviors were higher health numeracy (OR per unit increase = 1.41; 95% CI = 1.06–1.90) and higher cancer worry (OR per unit increase = 1.73; 95% CI = 1.36–2.22) (Table 4). Similarly, higher health numeracy (OR = 2.27; 95% CI = 1.35–3.95) and higher cancer worry (OR = 2.14; 95% CI = 1.44–3.24) also were associated with seeking additional information about genetic testing. Living in Puerto Rico (vs. Florida, OR = 2.75; 95% CI = 1.35–5.77) also was associated with information seeking about genetic testing.

4. Discussion and conclusion

4.1. Discussion

After receipt of information about skin cancer prevention, over half of the study participants had some type of communication within their network. Regardless of recipient, greater perceived severity and greater perceived risk were the most important factors associated with

Table 4
Results from multivariate logistic regression models examining information seeking about prevention behaviors and genetic testing for skin cancers.[a]

Predictors	Prevention behaviors for skin cancer		Genetic testing for skin cancers	
	$n = 477$		$n = 242$	
	OR	95% CI	OR	95% CI
Demographics				
Puerto Rican (ref.: other)	1.43	0.91–2.27	–	–
Health numeracy	**1.41**	**1.06–1.90**	**2.27**	**1.35–3.95**
Experience				
Study location				
Puerto Rico (ref.: Florida)	–	–	**2.75**	**1.35–5.77**
Salience				
Perceived severity	1.56	0.96–2.54	2.04	0.89–4.85
Cancer worry	**1.73**	**1.36–2.22**	**2.14**	**1.44–3.24**
Study arm[a]				
Average risk (ref. standard risk)	0.59	0.33–1.04	–	–
Higher risk (ref. standard risk)	1.06	0.67–1.68		
Higher risk (ref. average risk)			0.95	0.46-1.97

Bolded values indicate statistically significant findings from the AIC models.
[a] All models were adjusted for study arm or genetic risk category.

communication. Nearly a third of participants sought additional information after receipt of information about skin cancer prevention, where one-fifth sought additional information about genetic risk. Greater levels of health numeracy and cancer worry were independently associated with information seeking. Although the educational materials provided in the intervention trial did not explicitly encourage participants to talk about or seek additional information on these topics, the overall communication activities were notable among study participants.

To our knowledge, our study is the first to evaluate communication behaviors about skin cancer after receipt of skin cancer prevention information among Hispanic individuals. In a small study of English-speaking patients (ethnicity unspecified) with a history of non-melanoma skin cancer that assessed communication about skin cancer risk at three months after being offered *MC1R* testing, 92% of participants communicated with family members with 49% reporting "some" or "a lot" of communication [39]. Fewer (80%) participants reported communicating with a physician, with 57% reporting "some" or "a lot" of communication. [39] In contrast, only 32% of our study participants spoke to their relatives about skin cancer risk and prevention and 8% of participants spoke to a health care provider. The latter low proportion may have arisen from the timing of our participant recruitment and provision of the intervention, which occurred before and after scheduled medical appointments, respectively. Thus, only participants with a follow-up appointment within nine months could have interacted with a provider in clinic during their observation time on the study.

Other studies have reported on "usual" communications about skin cancer risk and prevention, i.e., in the absence of prior provision of prevention information, some of which enrolled Hispanic individuals. A large qualitative study recently reported that Hispanic people have limited to no communication about skin cancer preventive behaviors [40]. In contrast, a large study ($n = 600$) found 66% of study participants, nearly half of whom identified as Hispanic, had previously discussed skin cancer risk with a family member [9]; and findings from the same research team's pilot study showed high levels of skin cancer communication within the family of participants, nearly half of whom identified as Hispanic [10]. A study of first-degree relatives of melanoma patients, predominately a non-Hispanic White study sample, found that half of participants spoke with a relative about melanoma risk [41]. These studies may have observed more communication than in our study because of the heightened threat appraisal among individuals with a personal history of non-melanoma skin cancers (NMSC) or a family history of melanoma, which could lead to an increase motivation to discuss skin cancer risk with others [9,10]. A personal history of two or more NMSC was an exclusion criterion for our study, and very few (<1%) participants reported a single diagnosis of either a basal cell or squamous cell carcinoma. A family history of melanoma and NMSC was reported by only 12% and 5% of participants, respectively. Results from post-hoc analysis of this subset of participants were similar to overall results: 52% reported communication about skin cancer risk and prevention, and 35% and 14% communicated with a relative and provider, respectively.

Based on prior studies on skin cancer communication [9,10,15,18] and CMIS [26,42], we expected factors related to demographics, personal experience, salience, and beliefs dimensions would be related to communication about skin cancer genetic risk and prevention. Although we identified several factors from each dimension that were related to communication specifically about prevention behaviors or genetic testing at the univariate level, only demographic factors, i.e., female sex and having lower levels of health literacy, and salience variables, i.e., having higher levels of perceived severity and perceived risk, were independently associated with communication of any kind. A prior study about family skin cancer communication similarly found that perceived risk was significantly related to more communication [9]; family history of cancer, and engaging in more sun protective behaviors were also significantly related to more communication.

Interestingly, perceived severity of skin cancer was the only factor significantly associated across different recipients (family, spouse, friends, and healthcare providers) of information, suggesting that perceived severity as a key motivator of communication among Hispanic people. Notably, self-efficacy for skin cancer prevention was not a significant factor in any communication model, yet response efficacy was identified as a significant factor for communication with relatives and friends. These findings are consistent with prior research [9] and the PMT [25] indicating that communication with relatives and friends is motivated by both threat appraisal (perceived risk and severity) and coping appraisal (response and self-efficacy). Surprisingly, factors important in Hispanic culture such as language preference, familism, and cancer fatalism, were not significantly related to any measured communication behaviors.

Older age, family involvement in health decisions, and perceived risk and severity were all significantly associated with communication with providers. A previous study about communication of genetic test results also found greater perceived cancer risk and intention to share test results with their family was related to communication with providers [43]. These findings lend support to threat appraisal and family relationship as key drivers of talking with about cancer genetic risk.

Our study found 31% of the participants sought additional information about skin cancer prevention behaviors and 21% sought additional information about genetic risk. In a small study of English-speaking patients with a history of non-melanoma skin cancer, 50% sought additional information about skin cancer; and similar to our findings, 15% of participants who opted for *MC1R* genetic testing sought additional information about genetic testing [39]. In general, we found that higher levels of health numeracy and cancer worry were independently associated with increased information seeking, which is comparable to a prior study that identified cancer worry to be related to information-seeking about cancer [16]. Interestingly, there were only small differences in the proportion of participants who sought additional information about genetic testing for skin cancer between the higher (22%) and average (18%) risk groups. Participants in Puerto Rico (28%) were more likely to seek additional information about genetic testing for skin cancer than participants living in Florida (14%), which may be attributed to Puerto Ricans having less access and awareness to genetics resources [44], resulting in more proactive information-seeking about genetic testing to satisfy their interest.

We note several study limitations. First, our findings may not be generalizable to all Hispanic people. Our study sample was mostly female, educated, and recruited from two geographic locations; and higher education (and low family influence in health) have previously been associated with *MC1R* genetic testing among Hispanic people [45].

Second, because most participants identified as Puerto Rican, we were unable to examine differences across Hispanic identities. Third, we lack information about communication activities for the 37% of participants who did not return at least one follow-up. Fourth, we did not collect data on the purpose of or barriers to communication nor did we solicit information on some cultural factors relevant to the Hispanic community, such as acculturation, machismo, and respect. These measures could be useful to further understand patterns of information sharing. Finally, CMIS additionally identifies two information carrier factors, information carrier characteristics (e.g., editorial tone, communication potential) and information utility, that also contribute to information seeking and should be explored in the context of skin cancer risk and prevention; but we did not measure information carrier factors in our study.

4.2. Innovation

This study evaluated language preference, familism, and fatalism—factors important within Hispanic culture—and their association with information sharing and information seeking about skin cancer prevention. Although prior research suggest these cultural factors should be considered when developing culturally sensitive intervention materials to promote communication behaviors about skin cancer prevention, they did not distinguish Hispanic individuals likely to engage in communication behaviors about skin cancer in our study. This study also evaluated information sharing and seeking among Hispanic people at two distinct geographies, and our findings suggest that communication behaviors were similar among Floridians and Puerto Ricans, with the exception of information seeking about genetic testing for which Puerto Rican residents might benefit from additional resources.

Finally, this study systematically evaluated communication by topic (i.e., prevention behaviors and genetic risk) and recipient of communication (i.e., relatives, friends, spouse/partner, and health care provider). Most prior studies evaluated communication of skin cancer risk with relatives [9,10,39,41], spouse/partner, friends, and providers [9], communication about genetic testing with relatives, and information seeking about skin cancer and genetic testing [39]. To our knowledge, our study is the first to evaluate skin cancer genetic testing communication with friends and spouse/partner and to elucidate how demographics, personal experience, salience, and beliefs variables promoting information sharing differ according to topic and recipient of communication. Our findings provide a first step to better understand important factors that can guide the development of interventions to improve awareness and engagement in skin cancer preventive behaviors in the Hispanic community.

4.3. Conclusion

Our results suggest several factors motivated individuals to seek and share information about skin cancer risk, genetic testing, and skin cancer prevention within their network. Particularly we found cancer salience is important to communication behaviors. This finding has implications for clinical care and suggests providers play a role in educating Hispanic patients about skin cancer risk. Considering that communication about health can promote and maintain preventive behaviors across the individuals who share and receive the information, additional research should evaluate if and what kinds of communication leads to skin cancer prevention practices at the individual, family, and community level. If communication results in cascading effects of increased uptake of preventive behaviors in the community, future interventions should explore strategies to foster communication about skin cancer risk with their family and healthcare providers within the Hispanic community.

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Declaration of Competing Interest

The authors report there are no competing interests to declare.

Data availability statement

Data presented in this study will be made available upon reasonable request to the corresponding author.

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Appendix A. Supplementary data

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