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UNIVERSITY OF CALIFORNIA,
IRVINE

Ethnic Disparities in the Frequency of Cancer Reported in Family Histories

THESIS

Submitted in partial satisfaction of the requirements
for the degree of

MASTER OF SCIENCE
in Genetic Counseling

by

Heather Renee Maves

Thesis Committee:

Professor Moyra Smith, Chair

Associate Adjunct Professor Pamela Flodman

Associate Professor Deepika Nathan

2018

DEDICATION

To

my family, Daniel, and Gretel in recognition of their patience as they allowed me to be selfishly consumed in my education the past two years.

Susan Swift, Mark Verardo, and Charles Sackerson: You have each played an important role to getting me where I am today.

“Comfort is the enemy of progress.”

-The Greatest Showman

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Abstract of the Thesis

Ethnic Disparities in the Frequency of Cancer Reported in Family Histories

By

Heather Renee Maves

Master of Science in Genetic Counseling

University of California, Irvine, 2018

Professor Moyra Smith, Chair

Objective: Analyze if disparities exist in cancer reporting between ethnicities when collecting family histories in a cancer genetic counseling setting.

Methods: Data was collected from 469 pedigrees from a cancer genetic counseling appointment at University California, Irvine from 1/2015 to 1/2017. Pedigrees selected were of the following ethnic backgrounds: non-Hispanic White, Hispanic, Asian, or Ashkenazi Jewish. The number of first and second-degree relatives was calculated for each pedigree. The number of first and second-degree relatives affected with cancer was calculated. The total reported with cancer was divided by total number of relatives to derive a percentage of cancer reported for each pedigree. The frequency of cancer was analyzed using contingency tables, non-parametric tests, and a Poisson regression.

Results: Cancer reporting was highest among non-Hispanic Whites and Ashkenazi Jews with median percentages of 22% and 27% of affected relatives respectively. The median

percentages of cancer reporting in both Hispanics and Asians were 10%. Ethnicity was a significant factor for determining the number of affected relatives reported when analyzed with Poisson regression.

Conclusions: Cancer is reported less in family histories with Hispanic or Asian ethnicity. CDC data reveals these ethnicities have lower cancer incidence rates compared to non-Hispanic Whites; however, the disparity in reporting is greater than the disparity in incidence rates. Therefore, incidence rates alone cannot fully explain the reporting disparity seen in this study. If cancer is underreported in minorities, this can cause truncated family histories. Knowing one's family history of cancer is imperative for appropriate medical management.

Preface

Motivation for Research

During an internship at the Cancer Center of Santa Barbara, I took family histories over the phone prior to the patient's genetic counseling appointment. During these phone calls, I asked about cancers in the family, cancer type, age at diagnosis, and ethnic background. Over time, I noticed a pattern between ethnicity and extent of cancer reporting in families. I recall one Hispanic patient mentioning she and her family were very close and got together every Sunday. When I asked about cancer in the family, she responded explaining they didn't talk about "stuff like that." Before starting this research, I questioned if people knew the benefits of sharing cancer information whether that would change their intrafamilial communication patterns. Before answering this question, generating data would be necessary to identify groups of people where cancer may be underreported.

Introduction

Cancer Classifications

All cancer is genetic, however not all cancer is hereditary. As we understand cancer today, it can be grouped into one of three classifications: hereditary, familial, and sporadic. On average, hereditary cancer accounts for about 5-10% of cancer, familial cancer accounts for up to 20%, and sporadic cancer accounts for the remaining 70-80% (cancer.gov and Hemminki, Sundquist, Bermejo 2007). These percentages can vary depending on the type of cancer. For example, 20% of prostate cancer is familial whereas only 2% of testicular cancer is considered familial (Hemminki, Sundquist, Bermejo 2007).

Hereditary cancer syndromes are genetic syndromes in which cancer is the dominant feature due to a predisposition caused by a pathogenic change in a single gene (Schneider 2012). Hereditary cancer syndromes are characterized by specific constellations of cancers and at young ages. For example, Lynch Syndrome can predispose individuals to colon cancer and uterine cancer at younger ages. More frequent than hereditary cancers are familial cancers. Familial cancers are thought to be caused by multiple inherited changes in genes combined with a shared environment that give a family a higher susceptibility to develop cancer. This can cause cancer at somewhat earlier ages and more frequently within a family than typically seen. Sporadic cancer accounts for most cancer incidences. Sporadic cancer is considered cancer that does not seem to “run in a family” and is typically due to other factors such as age, exposures, or infectious diseases. When analyzing a family history, genetic counselors try to place the known

family cancer history into one of these classifications to provide a risk assessment to the patient. The risk assessment then guides screening recommendations, medical management, and qualification for genetic testing. Genetic testing would be offered if the cancer history was suspicious for a hereditary cancer syndrome. Prior to genetic testing, an initial risk assessment for hereditary cancers or cancer risk can begin with a pedigree.

The Pedigree

A pedigree is an illustration of family members spanning multiple generations using shapes and lines to depict males and females and how individuals are related. Included on the pedigree is a representation of each of the family member's physical and mental health. The pedigree is a screening tool that can be used for the general population by trained health care professionals to assess risk and inheritance patterns. Information on a pedigree can identify which individuals are at an increased risk to develop cancer and/or to inherit a cancer predisposition gene as seen in hereditary cancers. Patterns on a pedigree such as cancer below 50 years old, multiple generations of cancer, and clusters of certain types of cancer can help identify if a patient is at increased risk for cancer, or a hereditary cancer syndrome (Hampel et al. 2015). The risk assessment generated from the pedigree can change medical management for cancer; guidelines can be found via the National Comprehensive Cancer Network (NCCN). The more information the patient knows, the more accurate the interpretation and management will be for the patient.

NCCN Guidelines

The National Comprehensive Cancer Network (NCCN) provides guidelines to standardize cancer screening, when to offer genetic testing for cancer syndromes, and other medical management for cancer such as treatment strategies. Because cancer screening can start with personal and family history of cancer, the NCCN recognizes information from one's pedigree and incorporates that into the guidelines for offering testing and early screening. The guidelines specifically list criteria for offering testing of breast cancer genes 1 and 2 (BRCA1/2) for Hereditary Breast and Ovarian Cancer Syndrome (HBOC). Some of the criteria for offering BRCA1/2 genetic testing are based on personal history of cancer, but many criteria are also dependent on family history (NCCN.org). For example, a woman who has breast cancer at the age of 50 years old and has another close relative with breast cancer is a candidate for offering genetic testing. It is important to offer genetic testing to identify if the patient is at increased risk for hereditary cancer versus familial or sporadic cancer. This allows health care professionals to assess the magnitude of increased risk, risks for other cancers, and to help identify which other family members are at risk. After identification of risk based on family history and/or genetic testing, appropriate screening and medical management can take place. The information on the pedigree is reliant on the patient being aware of cancers in the family to be effectively utilized. Being aware of one's family history can change whether one meets NCCN criteria for genetic testing and therefore may impact whether genetic testing is offered.

Cancer Incidence Rates in Different Ethnicities

Hispanics and Asians have a lower cancer incidence rate compared to non-Hispanic Whites and therefore cancer may be reported less frequently in these populations. Data from the Center for Disease Control (CDC) estimates cancer incidence in the United States by ethnicity and gender. Numbers taken from the 2014 data show male incidence rates of cancer were 459.7, 351.5, and 272.0 per 100,000 non-Hispanic Whites, Hispanics, and Asians respectively (CDC.gov). Female incidence rates of cancer were 414.0, 322.4, and 277.2 per 100,000 non-Hispanic Whites, Hispanics, and Asians respectively (CDC.gov). If there is a disparity of cancer incidence reporting between non-Hispanic Whites, Hispanic and Asian pedigrees, this could partly be explained by the difference in cancer incidence rates. However, if the disparity in reporting is larger than the difference in cancer incidence rates, other reasons should be explored to further analyze the increased disparity of reporting cancer in family members. Other reasons may include negative stigma associated with cancer, lost family history or low health literacy.

Evidence of Disparity in Cancer Reporting in Minority Populations

Data from multiple studies suggest that cancer may be reported less frequently in minority populations. One study explored reasons for ethnic disparities in the awareness of genetic testing for cancer risks. In 2009, Pagan et al. gathered data on how frequently a parent was reported to have cancer. In the demographics, 37% percent of non-Hispanic Whites

reported having a parent affected with cancer compared to 17%, 22.5% and 14.4% of Hispanics, African Americans, and Asians respectively (Pagan et al. 2009). In these minority populations, parents were reported to have cancer less than half as frequently compared to non-Hispanic whites. Was this difference a reflection of cancer incidence or was cancer communicated less frequently to children whose parents were Hispanic, African American or Asian?

Another study assessed disparities in screening behaviors of individuals with a family history of cancer between different ethnic groups (Ponce et al. 2012). Demographics from the study suggest that non-Latino Whites reported having a family history of cancer more often. The Latino and Asian & Pacific Islander groups contributed significantly less to the groups that reported having a family history of cancer compared to the groups that had no family history of cancer. This was true for families being studied for family history of either breast or colorectal cancer. These studies suggest that non-Latino Whites report a family history of cancer more often than Latinos and Asians. However, the frequency of cancer reporting was not an intended variable studied.

Benefits of Sharing Family History of Cancer

There are benefits to sharing cancer history within a family from a medical standpoint. With a comprehensive family history, the cancer seen in the family can be categorized appropriately as hereditary, familial, or sporadic. If hereditary cancer is suspected, one may be offered genetic testing or referred to genetic counseling (Lu et al. 2014). Depending on cancers

reported in the family, the affected and/or unaffected patient and family members may be eligible for earlier and more aggressive screening than the general population (NCCN.org). Lastly, family members who reported cancer in their parents were more likely to be familiar with services such as genetic testing (Pagan et al. 2009). In summary, information from shared family history of cancer can be used to accurately categorize and manage the cancer seen in the family. Additionally, awareness of family cancer history may increase health literacy.

Risks of Sharing Family History of Cancer

Sharing family history of cancer may have associated risks that include negative stigma, invasion of traditions of privacy, and emotionally burdening relatives. One study explored attitudes and beliefs about cancer in the Latino population, and found participants reported they did not want their family members to know they have cancer. These participants reported cancer was associated with negative stigma such as suffering, imminent death, and overbearing financial burdens (Kinney et al. 2010). Additionally, threatening a family's respect for privacy by sharing health history can stress relationships (Peters et al. 2011). Furthermore, the feeling of emotionally burdening relatives was reported by participants in a study analyzing communication about BRCA1/2 susceptibility. Participants reported hesitation to divulging information because relatives had "their own troubles," and reported hearing family members mention "they did not want to know" information that revealed negative health news (Peters et al. 2011). Families dynamics are complex which can make sharing personal and family history of cancer seem as more of a risk than a benefit.

Hypothesis

The hypothesis to be studied is that minority ethnic groups including Hispanics and Asians report cancer less frequently in family histories compared to non-Hispanic Whites and Ashkenazi Jews. This study is designed to identify if there is a disparity in cancer family history reporting between different ethnicities including non-Hispanic Whites, Hispanics, Asians, African Americans, and Ashkenazi Jewish. The aims of this study are to:

1. Identify if there are significantly different rates of cancer reporting among first and second-degree relatives and ethnic populations including non-Hispanic Whites, Hispanic, Asian, African American, and Ashkenazi Jewish populations.
2. Identify if there are significant differences between ethnic groups in the proportion of people who seek genetic counseling based on a personal history of cancer versus a family history of cancer.
3. Identify if there are significant differences between ethnic groups in the proportions of patients who qualify for BRCA1/2 genetic testing based on current NCCN guidelines.

If non-Hispanic Whites and Ashkenazi Jews report cancer more frequently, it is expected that unaffected probands would come in for genetic counseling more frequently compared to Hispanics and Asians. Additionally, it would also be expected that non-Hispanic Whites and Ashkenazi Jews would qualify for BRCA1/2 testing based on family history more frequently than Hispanics and Asians.

Research Methods and Design

Collection of Pedigrees

After University of California Irvine institutional review board approval of application HS#2017-3983, 469 pedigrees were obtained from the Cancer Genetics (CaGen) database maintained at the University of California, Irvine. The database was created in 2014 to track patients, patient demographics, patient pedigrees, patient testing status and results. Pedigrees for this research included those collected between January 1, 2015 to January 30, 2017. During this time, there was primarily one genetic counselor collecting family history from patients and drawing the pedigrees along with students under her supervision. Eligible pedigrees were those with a reported ethnicity such that both sides of the family were predominantly one of the following: non-Hispanic White, Hispanic, Asian, and African American. To be considered Ashkenazi Jewish, only one side of the family was required to be of Ashkenazi Jewish descent. Non-Hispanic White was defined as non-Hispanic and non-Ashkenazi Jewish; however, this category will be continually referred to as “non-Hispanic White” for simplicity in this study. Pedigrees were excluded if the majority ethnicity was not distinguishable or if the maternal ethnicity was different from the paternal ethnicity. If there were multiple pedigrees of the same family, only one pedigree from that family was included. The pedigree included in the study was typically from the proband’s initial consultation. A proband is described as a person in the family who initially brings the family to medical attention for being affected or at risk for the condition

being examined. For this study, if a family member sought genetic counseling after a proband was initially seen, the proband's pedigree was included for the study, and the family member's pedigree was excluded.

Variables collected

1. Pedigrees were separated by reported ethnicity. The number and gender of first and second-degree relatives over the age of 18 were totaled in each pedigree. First degree relatives would be biological parents, full siblings, and biological children. Second degree relatives are grandparents, aunts and uncles, nieces and nephews, and grandchildren. Half siblings are also second-degree relatives. Refer to Figure 1 for examples of first and second-degree relatives.

The number of first and second-degree relatives that were reported to have cancer diagnosed over the age of 18 and the cancer type was collected for each pedigree. For this study, cancer was defined as a malignant neoplasm. Those with carcinoma *in situ* were considered affected. Polyps or cancers that were documented as "benign" were excluded and therefore these relatives were not considered as affected with cancer. A percentage was calculated for each pedigree in which the number of first degree and second-degree relatives affected with cancer defined the numerator and the total number of first and second-degree relatives reported defined the denominator. Family members under the age of 18 were not included because this study is designated to investigate cancer reporting among adults.

1: First-Degree Relative (FDR): parents, siblings, and children

2: Second-Degree Relative (SDR): grandparents, aunts, uncles, nieces, nephews, grandchildren, and half-siblings

Figure 1: Examples of First and Second-Degree Relatives

2. The proband was the patient scheduled for the genetic counseling appointment. The proband of each pedigree was documented as affected or unaffected with cancer. For this study cancer was defined as malignant neoplasms and excluded benign neoplasms. Probands with carcinoma

in situ were considered affected. Patients documented with polyps were documented as unaffected and those with a benign neoplasm were considered unaffected.

3. Information was collected that assigned a qualification category for each proband regarding BRCA1/2 genetic testing. A choice of three different categories could be assigned. Probands qualified for BRCA1/2 genetic testing based on:

- a. Personal history of cancer
- b. Family history of cancer
- Or,
- c. They do not qualify for BRCA1/2 genetic testing.

Qualifications were made based on NCCN guidelines for offering BRCA1/2 genetic testing. If a patient qualified based on personal history, then no additional information from the family history was required to offer testing. For example, a woman affected with ovarian cancer would automatically qualify for BRCA1/2 genetic testing, as well as a woman diagnosed with breast cancer at the age of 45 years old or younger (NCCN.org). These women would then qualify based on personal history and would be assigned category (a). Those who qualify based on family history required information from the family history to meet the NCCN guidelines to offer testing. For example, women diagnosed with breast cancer at 47 years old would qualify for BRCA1/2 testing if they had an additional close family member affected with breast cancer at any age (NCCN.org). These patients would then be assigned category (b). Lastly, a patient would not qualify for BRCA1/2 testing if the personal and family history of cancer did not meet NCCN guidelines. This patient would then be assigned in category (c). Version 1.2018 – October

3, 2017 on NCCN.org lists all the comprehensive qualifications used for this study. It is important to mention that there are genes other than BRCA1/2 that contribute to hereditary cancer syndromes. Other genes responsible for hereditary cancer syndromes or increased cancer risks may not have clear NCCN guidelines for offering testing, or the information for offering genetic testing may not be documented on the pedigree. Information may be on pathology reports or on consultation notes which were not collected as part of this study. BRCA1/2 genetic testing criteria were used for this study because the criteria are comprehensively described by the NCCN and are parallel with the information documented on the pedigrees analyzed.

Statistical Analysis

Data was collected in a coded data collection spreadsheet which contained information matching individual's data to the original pedigree. After completion of data collection, the coded information was deleted and the excel was manipulated appropriately to import in to IBM SPSS version 25 statistical software.

A total of 469 pedigrees were reviewed. Thirty-five pedigrees with over 400 data entry points were re-collected separately and compared to originals for accuracy. A 3.7% error was calculated when the recollected data was compared to original data. Errors within the thirty-five pedigrees were corrected if the error was in the original data collection. This error rate has been accepted to move forward with data review and analysis.

Descriptive analysis was used to present information gathered including demographics and family sizes. For comparisons between the ethnic groups of categorical variables, column proportions were analyzed using the z-test, using Bonferroni correction when appropriate, to evaluate where significant differences (≤ 0.05) occurred. Non-parametric tests were used to analyze differences in distributions and medians of continuous data. A Poisson regression was used to model the effect of ethnicity on determining the number of relatives reported with cancer, correcting for different family sizes.

Results

Information from a total of 469 pedigrees was collected from the CaGen database from January 1, 2015-January 31, 2017. Table 1 presents descriptive characteristics of pedigree information separated by reported ethnicities.

A total of 199 pedigrees were obtained for the non-Hispanic Whites, 131 Hispanics, 94 Asian, 33 Ashkenazi Jewish, and 12 African American. Due to the low number of African American pedigrees, data analysis will not be significant and therefore African American data was excluded, however, descriptive information is included in Table 1.

Table 1: Demographic and Descriptive Data Collected from 469 Pedigrees

<i>Data</i>	<i>non-Hispanic White</i>	<i>Hispanic</i>	<i>Asian</i>	<i>AJ</i>	<i>AA</i>
<i>Total Pedigrees</i>	199	131	94	33	12
<i>1/2015 – 1/ 2017</i>					
<i>Gender</i>					
<i>Males</i>	61 (30.7%)	23 (17.6%)	17 (18.1%)	10 (30.3%)	3 (25%)
<i>Females</i>	138 (69.3%)	108 (82.4%)	77 (81.9%)	23 (69.7%)	9 (75%)
<i>Age (years)</i>					
<i>Mean</i>	57	52	56	57	51
<i>Median</i>	58	51	55	58	52.5
<i>Minimum</i>	22	21	23	23	28
<i>Maximum</i>	87	80	89	87	71
<i>Proband Status</i>					
<i>Affected w/ Cancer</i>	120 (60.3%)	96 (73.3%)	64 (68.1%)	12 (36.4%)	6 (50%)
<i>Unaffected</i>	79 (39.7%)	35 (26.7%)	30 (31.9%)	21 (63.6%)	6 (50%)
<i>Total # of FDR and SDR</i>					
<i>Mean</i>	16.04	23.63	18.54	13.27	19
<i>Median</i>	15	23	18	13	17
<i>Percentage of Cancer Reporting</i>					
<i>Mean</i>	0.24	0.11	0.12	0.29	0.20
<i>Median</i>	0.22	0.10	0.10	0.27	0.17
<i>Pedigrees and Family History</i>					
<i>No Family History of Cancer</i>	5 (2.5%)	24 (18.3%)	20 (21.3%)	0 (0.0%)	1 (8.3%)
<i>Positive Family History of Cancer</i>	194 (97.5%)	107 (81.7%)	74 (78.7%)	22 (100.0%)	11 (91.7%)
<i>BRCA1/2 Qualification</i>					
<i>a</i>	33 (16.6%)	34 (26.0%)	31 (33.0%)	5 (15.2%)	2 (16.7%)
<i>b</i>	75 (37.7%)	33 (25.2%)	22 (23.4%)	21 (63.6%)	2 (16.7%)
<i>c</i>	91 (45.7%)	64 (48.9%)	41 (43.6%)	7 (21.2%)	8 (66.6%)

AJ: Ashkenazi Jewish

AA: African American

FDR: First Degree Relative

SDR: Second Degree Relative

Proband: Patient Scheduled for Genetic Counseling Session

No family History of Cancer: Proband did not report any relatives affected with cancer

Positive Family History of Cancer: Proband reported at least one or more relatives affected with cancer

Percentage: Total First and Second Relatives Affected with Cancer/Total First and Second-Degree Relatives Reported

a: Qualified for BRCA1/2 testing based on personal history per NCCN guidelines

b: Qualified for BRCA1/2 testing based on information from family history per NCCN guidelines

c: Did not qualify for BRCA1/2 testing based on information provided on pedigree per NCCN guidelines

Descriptive Data

Age

The age range was similar between ethnicities from early 20s to 80s. It is of note, age was calculated as birth year subtracted from 2018, therefore ages are not precise. Ages were normally distributed in each ethnicity analyzed via the Kolmogorov-Smirnov test of normality (Figure 2 and Table 2). Age distribution between ethnicities was compared by one-way ANOVA with post-hoc Tukey test. Only non-Hispanic Whites and Hispanics were significantly different from each other, with the median ages of non-Hispanic White and Hispanic at 58 and 51 years old respectively. Ages were binned in 15-year increments or more. There was a significant difference in the proportion of probands between the non-Hispanic Whites and the Hispanics in both the 36-50 and >66 age bins (Table 3).

Ages were calculated by birth year alone and are therefore not exact
 AJ: Ashkenazi Jewish

Figure 2: Distribution of Proband Ages Across Ethnicities

Table 2: Normality Test for Distributions of Ages by Ethnicity

Kolmogorov-Smirnov^a Test of Normality

	<i>Statistic</i>	<i>DoF</i>	<i>p-value</i>
<i>non-Hispanic White</i>	.061	199	.069
<i>Hispanic</i>	.064	130	.200*
<i>Asian</i>	.071	94	.200*
<i>AJ</i>	.134	33	.138

^a Lilliefors Significance Correction

* This is the lower bound of the true significance

DoF: Degrees of Freedom

Significant difference $p \leq 0.05$

Table 3: Age Distribution per Ethnicity

<i>Proband Age in Years</i>	<i>non-Hispanic White</i>	<i>Hispanic</i>	<i>Asian</i>	<i>AJ</i>
<i>20-35</i>	22 (11.1%)	17 (13.1%)	8 (8.5%)	5 (15.2%)
<i>36-50</i>	39 (19.6%)*	44 (33.8%)*	21 (22.3%)	7 (21.2%)
<i>51-65</i>	75 (37.7%)	45 (34.6%)	40 (42.6%)	8 (24.2%)
<i>>66</i>	63 (31.7%)*	24 (18.5%)*	25 (26.6%)	13 (39.4%)
<i>Total</i>	199 (100%)	130** (100%)	94 (100%)	33 (100%)

*column proportions between ethnicities significantly different ($p \leq 0.05$)

**missing age data from one proband

AJ: Ashkenazi Jewish

Proportions of Males and Females

Males and females were represented in all ethnicities analyzed. Females accounted for proportionately over 50% of all probands in each ethnicity. Males were proportionally least represented in the Hispanic and Asian populations. There was a significant difference in the proportions of males and females between non-Hispanic Whites and Hispanics. The proportion of males was significantly smaller in Hispanics compared to non-Hispanic Whites (Table 4 and Figure 3).

Table 4: Proportions of Males and Females per Ethnicity

<i>Gender</i>	<i>non-Hispanic White</i>	<i>Hispanic</i>	<i>Asian</i>	<i>AJ</i>
<i>Males</i>	61 (30.7%)*	23 (17.6%)*	17 (18.1%)	10 (30.3%)
<i>Females</i>	138 (69.3%)*	108 (82.4%)*	77 (81.9%)	23 (69.7%)
<i>Total</i>	199 (100%)	131 (100%)	94 (100%)	33 (100%)

*Column proportions between ethnicities significantly different ($p \leq 0.05$)

AJ: Ashkenazi Jewish

Significant difference ($p < 0.05$) in gender proportions between non-Hispanic Whites and Hispanics

AJ: Ashkenazi Jewish

Figure 3: Gender of Proband per Ethnicity

Total Relatives

The median number of first and second-degree relatives differed between ethnic groups. Non-Hispanic Whites and Ashkenazi Jews reported fewer first and second-degree relatives with medians of 15 and 13 total relatives respectively, compared to Hispanic and Asians whose medians were 23 and 18 total relatives respectively (Figure 4).

AJ: Ashkenazi Jewish
FDR: First Degree Relative
SDR: Second Degree Relative

Figure 4: Distributions of Number of First and Second-Degree Relatives Reported Across Ethnicities

Data Analysis

Distribution of Percentages of Cancer Reporting Between Ethnicities

Total number of relatives reported to have cancer in each family per ethnicity were calculated. The average numbers of relatives reported to be affected with cancer in each family were 3.54, 2.46, 2.09, 3.64 for non-Hispanic Whites, Hispanics, Asians, and Ashkenazi Jews respectively.

A percentage of affected relatives was calculated for each family by dividing the total number of affected relatives by the total number of relatives reported. The median percentages of reported affected relatives were 22%, 10%, 10% and 27% for non-Hispanic Whites, Hispanics, Asians, and Ashkenazi Jews respectively (Figure 5). The percentage of relatives who were reported to be affected were not all normally distributed when separated by ethnicity and analyzed with the Kolmogorov-Smirnov test of normality (Table 5). Therefore, distributions of percentages per ethnicity were compared using the non-parametric median and Kruskal-Wallis tests. When comparing all ethnicities together, there was a significant difference ($p \leq 0.05$) in both the median percent of relatives reported to have cancer and the distribution of percentages.

Proportion of Cancer Reporting: Total first and second-degree relatives affected/total first and second-degree relatives reported.

Non-Hispanic White Median: 22%

Hispanic Median: 10%

Asian Median: 10%

Ashkenazi Jewish (AJ) Median: 27%

Figure 5: Histograms of Proportion of Cancer Reporting per Ethnicity

Table 5: Normality Test for Distributions of Percentages of Cancer Reported by Ethnicity

Kolmogorov-Smirnov^a Test of Normality

	<i>Statistic</i>	<i>DoF</i>	<i>p-value</i>
<i>non-Hispanic White</i>	.067	199	.030
<i>Hispanic</i>	.126	131	.000
<i>Asian</i>	.128	94	.001
<i>AJ</i>	.104	33	.200*

^a Lilliefors Significance Correction

* This is the lower bound of the true significance

DoF: Degrees of Freedom

Significant difference $p \leq 0.05$

AJ: Ashkenazi Jewish

The Kruskal-Wallis test does not confirm where differences occurred; therefore, further analysis of pairwise comparisons were made using the Mann-Whitney test. There was a significant difference in both medians and distributions of percentages between the non-Hispanic Whites and Hispanics as well as between the non-Hispanic Whites and Asians ($p < 0.001$). There was not a significant difference of the medians and distributions of percentages between the Hispanic and Asians. There was not a significant difference between non-Hispanic Whites and Ashkenazi Jews. All pairwise comparisons are seen in Table 6. Overall non-Hispanic Whites and Ashkenazi Jews had similar patterns of reporting percentages; Hispanics and Asians had similar patterns of reporting percentages.

Table 6: Pairwise Comparisons of Medians and Distributions of Percentages of Cancer Reporting

<i>Mann-Whitney Pairwise Comparisons: Percentage of Cancer Reporting</i>		
<i>Ethnicities Compared</i>	Comparison	Significance (p)
<i>non-Hispanic White vs. Hispanic</i>	Median	<0.001*
	Distribution	<0.001*
<i>non-Hispanic White vs. Asian</i>	Median	<0.001*
	Distribution	<0.001*
<i>non-Hispanic White vs. AJ</i>	Median	0.237
	Distribution	0.130
<i>Hispanic vs. Asian</i>	Median	0.902
	Distribution	0.762
<i>Hispanic vs. AJ</i>	Median	<0.001*
	Distribution	<0.001*
<i>Asian vs. AJ</i>	Median	<0.001*
	Distribution	<0.001*

* Significant difference ($p \leq 0.05$) between ethnicities compared

AJ: Ashkenazi Jewish

Bins for the percentages of reported affected relatives were created with ranges from 0-20%, >20%-40%, and >40%. Proportions for each bin were then compared across ethnicities. Hispanics and Asians reported between 0-20% affected relatives proportionately more frequently than non-Hispanic Whites and Ashkenazi Jews. Non-Hispanic Whites and Ashkenazi Jews reported >20-40% and >40% affected relatives proportionately more frequently than Hispanic and Asians (Table 7 and Figure 6).

Table 7: Bins of Percentage of Cancer Reporting per Ethnicity

Percentage Range	non-Hispanic White	Hispanic	Asian	AJ
0-20%	89 (44.7%)	112 (85.5%)*	75 (79.8%)*	12 (36.4%)
>20%-40%	91 (45.7%) ⁰	18 (13.7%)	18 (19.1%)	14 (42.4%) ⁰
>40%	19 (9.5%) ¹	1 (0.8%)	1 (1.1%)	7 (21.2%) ¹
Total	199 (100%)	131 (100%)	94 (100%)	33 (100%)

Percentage of Cancer Reporting: total first and second-degree relatives affected/total first and second-degree relatives reported.

*Proportions significantly ($p \geq 0.05$) higher in 0-20% range

⁰Proportions significantly ($p \geq 0.05$) higher in >20-40% range

¹Proportions significantly ($p \geq 0.05$) higher in >40% range

AJ: Ashkenazi Jewish

Figure 6: Bins of Percentage of Cancer Reporting per Ethnicity

A Poisson regression was used to model whether ethnicity was a significant factor in determining how many relatives are reported to be affected with cancer. A Poisson regression was deemed appropriate because the percentages of relatives reported to have cancer was not normally distributed in each ethnicity group and because the Poisson regression can offset based on family size. Independent variables entered were ethnicity and age of the proband, and the offset variable was family size (total number of first and second-degree relatives reported). The dependent variable was total number of relatives affected. Both ethnicity and age were significant factors in predicting the total number of relatives affected. Coefficients from the Poisson regression estimated that Ashkenazi Jews have the highest percentage of cancer reported per first and second-degree relatives followed by non-Hispanic Whites and Asians. Hispanics were modeled to report cancer in first and second-degree relatives the least compared to the other ethnicities analyzed (Table 8).

Table 8: Poisson Regression Output

<i>Poisson Regression Output</i>				
<i>Parameter</i>	<i>B</i>	<i>Std. Error</i>	<i>DOF</i>	<i>Significance</i>
<i>Intercept</i>	-2.52	0.1261	1	<0.001
<i>Non-Hispanic White</i>	-6.865	0.1222	1	<0.001
<i>Hispanic</i>	-18.747	0.1158	1	<0.001
<i>Asian</i>	-12.419	0.1286	1	<0.001
<i>Ashkenazi Jewish</i>	0 ^a		1	
<i>Age</i>	-0.258	0.0025	1	<0.001
<i>Scale</i>	1 ^b			<0.001

Dependent Variable: Total number of affected first and second-degree relatives

Model Variables: Ethnicity and Age

Model Offset: Total first and second-degree relatives

a: Set to zero because this parameter is redundant

b. Fixed at the displayed value

Categorical Data

Categorical data compared across ethnicities included:

1. Whether the proband was affected or unaffected with cancer.
2. The number of families that reported "no family history" versus a "positive family history" of cancer.
3. Qualification of BRCA1/2 testing in three categories based on information provided in the pedigree: a) eligible due to personal history b) eligible due to family history or c) not eligible to be offered testing.

The proportion of probands who were affected with cancer was greater in each ethnic group compared to probands who were unaffected with cancer, with exception to the Ashkenazi Jews. There was a significantly greater proportion of Ashkenazi Jewish probands who were not affected with a personal history of cancer compared to the Hispanic and Asian probands (Table 9).

Table 9: Proband Not Affected vs. Affected with Cancer per Ethnicity

<i>Personal History of Cancer</i>	<i>non-Hispanic White</i>	<i>Hispanic</i>	<i>Asian</i>	<i>AJ</i>
<i>Not Affected</i>	79 (39.7%)	35 (26.7%)	30 (31.9%)	21 (63.6%)*
<i>Affected</i>	120 (60.3%)	96 (73.3%) ⁰	64 (68.1%) ⁰	12 (36.4%)
<i>Total</i>	199 (100%)	131 (100%)	94 (100%)	33 (100%)

* Column proportion is significantly greater ($p \leq 0.05$) compared to Hispanic and Asian

⁰ Column proportions are significantly greater ($p \leq 0.05$) compared to AJ

AJ: Ashkenazi Jewish

The proportion of non-Hispanic Whites who reported a “positive family history” of cancer was significantly greater than Hispanic and Asians. Inversely, the proportion Hispanic and Asians that reported “no family history” was significantly greater than the non-Hispanic Whites (Table 10). Ashkenazi Jews were not used in comparisons because one of their column proportions was equal to zero (all pedigrees in this ethnic group included a family history of cancer).

Table 10: No Family History vs. Positive Family History of Cancer per Ethnicity

	<i>non-Hispanic White</i>	<i>Hispanic</i>	<i>Asian</i>	<i>AJ</i>
<i>No Family History</i>	5 (2.5%)*	24 (18.3%)**	20 (21.3%)**	0 (0.0%)
<i>Positive Family History</i>	194 (97.5%) ⁰⁰	107 (81.7%) ⁰	74 (78.7%) ⁰	33 (100.0%)
<i>Total</i>	199 (100%)	131 (100%)	94 (100%)	33 (100%)

No Family History: No first or second-degree relatives reported with cancer

Positive Family History: One or more first or second-degree relatives reported with cancer

** Column proportion between ethnicities significantly ($p \leq 0.05$) less*

*** Column proportion between ethnicities significantly ($p \leq 0.05$) more*

⁰ Column proportion between ethnicities significantly ($p \leq 0.05$) less

⁰⁰ Column proportion between ethnicities significantly ($p \leq 0.05$) more

AJ not used in comparison because one of their column proportions was equal to zero.

AJ: Ashkenazi Jewish

Proportions were further compared, restricting the analysis to only those pedigrees for which the proband was affected. From those who were personally affected with cancer, the proportion of non-Hispanic Whites who also reported a family history was significantly greater compared to Hispanics and Asians (Table 11 and Figure 7). Ashkenazi Jews were not used in comparisons because one of their column proportions was equal to zero (all pedigrees in this ethnic group included a family history of cancer).

Table 11: Affected Probands and No Family History vs. Positive Family History of Cancer per Ethnicity

<i>Proband Affected with Cancer</i>	<i>non-Hispanic White</i>	<i>Hispanic</i>	<i>Asian</i>	<i>AJ</i>
<i>No Family History</i>	5 (4.2%)*	22 (22.9%)**	17 (26.6%)**	0 (0.0%)
<i>Positive Family History</i>	115 (95.8%) ⁰⁰	74 (77.1%) ⁰	47 (73.4%) ⁰	12 (100.0%)
<i>Total</i>	120 (100%)	96 (100%)	64 (100%)	12 (100%)

No Family History: No first or second-degree relatives reported with cancer

Positive Family History: One or more first or second-degree relatives reported with cancer

* Column proportion significantly ($p \leq 0.05$) less for no family history

** Column proportion significantly ($p \leq 0.05$) more for no family history

⁰ Column proportion significantly ($p \leq 0.05$) less for positive family history

⁰⁰ Column proportion significantly ($p \leq 0.05$) more for positive family history

AJ not used in comparison because its column proportion was equal to zero.

AJ: Ashkenazi Jewish

Figure 7: Affected Probands and No Family History vs. Positive Family History per Ethnicity

Qualification for BRCA1/2 testing was grouped into three categories. The proportions of non-Hispanic Whites, Hispanics, and Asians that qualified for genetic testing based on family history was significantly less compared to Ashkenazi Jews (Table 12 and Figure 8).

Table 12: BRCA1/2 Qualification per Ethnicity

<i>BRCA1/2 Qualification</i>		<i>non- Hispanic White</i>	<i>Hispanic</i>	<i>Asian</i>	<i>AJ</i>
<i>a</i>		33 (16.6%)	34 (26.0%)	31 (33.0%) ⁰	5 (15.2%)
<i>b</i>		75 (37.7%)	33 (25.2%)	22 (23.4%)	21 (63.6%)*
<i>c</i>		91 (45.7%)	64 (48.9%)	41 (43.6%)	7 (21.2%)

a: Qualified for BRCA1/2 testing based on personal history

b: Qualified for BRCA1/2 testing based on some information from family history

c: Did not qualify for BRCA1/2 testing based on information provided on pedigree

** Column proportion significantly ($p \leq 0.05$) greater than other ethnicities for category b.*

⁰ Column proportion significant greater than column proportion of non-Hispanic White for category (a)

AJ: Ashkenazi Jewish

AJ: Ashkenazi Jewish

a: Qualified for BRCA1/2 testing based on personal history

b: Qualified for BRCA1/2 testing based on information from family history

c: Did not qualify for BRCA1/2 testing based on information provided on pedigree

AJ proportion of category b is significantly ($p \leq 0.05$) greater compared to all other ethnicities.

AJ: Ashkenazi Jewish

Figure 8: Proportions of BRCA1/2 Qualification per Ethnicity

Discussion

Ethnic Disparity of Cancer Reporting

This study comparing cancer reporting in first and second-degree relatives between different ethnicities shows that there are significant differences. Similarities were observed between non-Hispanic Whites and Ashkenazi Jews and similarities were observed between Hispanics and Asians. Hispanics and Asians both report cancer in first and second-degree

relatives less often than non-Hispanic Whites and Ashkenazi Jews. These results reflect what has been witnessed in previous studies. Pagan et al. witnessed a reduced frequency in how often individuals report a parent affected with cancer in minority populations including Hispanics, African Americans, and Asians (Pagan et al. 2009). In addition, Ponce et al. observed significant differences in how Latinos and Asians contributed to the groups that did and did not report a family history of cancer. Both Latinos and Asians were significantly underrepresented in groups that reported a family history of breast and colorectal cancer (Ponce et al. 2012). This study combined with previous studies raises awareness of the reduced cancer reporting in Hispanics and Asians.

This study was not designed to extrapolate whether a disparity of cancer reporting in relatives exists due to a reduction in cancer incidence or a reduction of cancer communication between family members. However, further comparisons were undertaken to attempt to understand if the disparities seen could solely be attributed to cancer incidence rates. Cancer incidence data from the CDC was averaged for men and women (CDC.gov). From there, the percentage of cancer incidence was compared between non-Hispanic Whites versus Hispanics and Asians. The incidence rate of cancer in Hispanic and Asians is 77.2% and 63.1% that of non-Hispanic Whites. What is interesting is that even though incidence rate is lower in these ethnicities, the rate that individuals report cancer in their families is even further reduced. Using the medians from this study, Hispanics and Asian report 45% the amount of cancer that non-Hispanic Whites report (Table 13).

Table 13: CDC Incidence Rates Compared to Cancer Reporting Rates

CDC Data			Current Study Data	
	Average male and female incidence rate per 100,000*	% of incidence to non-Hispanic Whites	Medians in current study	% of reporting to non-Hispanic Whites
non-Hispanic White	443.4	100%	0.22	100%
Hispanic	342.4	77.2%	0.10	45%
Asian	279.7**	63.1%	0.10	45%

*Incidence rates per CDC.gov data for 2014

** Asian: Asian and Pacific Islander for CDC data

Using the percentages from the CDC incidence data, it was predicted how many relatives should have been reported to have cancer from the total number of relatives in this study. Because non-Hispanic Whites report the most affected relatives at 22%, this number remained fixed. Based on the percentage of CDC incidence rates, it was predicted that Hispanics should report cancer in about 17% of their relatives (77.2% of 22%) and Asian should report cancer in about 14% of their relatives (63.1% of 22%). From here, expected values were compared to observed values and analyzed with a chi-square to determine if there is a significant difference. It is noteworthy this comparison is not perfect because age and gender of relatives was not taken into consideration. Ideally, this comparison would be done separately for males and females with ages taken into consideration. The chi-square analysis shows a significant difference in the observed versus expected number of relatives affected from both the Hispanic and Asian populations. Both groups reported fewer relatives affected with cancer than expected

(Table 14). See Table 20 in appendix for calculations deriving expected numbers of relatives affected with cancer from CDC cancer incidence data.

Table 14: *Chi-Square Goodness of Fit: Observed vs. Expected Reported Relatives with Cancer (Hispanic and Asian)*

<i>Goodness of Fit</i>				
	<i>Observed</i>	<i>Expected</i>	<i>(o-e)²/e</i>	<i>Significance</i>
<i>Hispanics</i>	322*	527.38 ⁰	79.98	p<0.001
<i>Asians</i>	196*	242.57 ⁰	8.94	
<i>Sum</i>			88.92	

*Collective number of relatives reported to be affected with cancer from all Hispanic or Asian families.

⁰See Table 20 for calculations on derived numbers

Degrees of Freedom: 2

Significant difference $p \leq 0.05$

In summary, it appears that the difference in cancer incidence rates cannot fully explain the reduced reporting of relatives in Hispanic and Asian populations. Although the comparison made here is not ideal considering gender and age are not accounted for, other factors such as negative stigma associated with cancer in Hispanic and Asian ethnicities, lost family history from migration or language barriers, and low health literacy may all contribute to the reduction in cancer reporting.

Family Communication About Cancer

This study was designed to capture what adults over the age of 18 report about their family history of cancer. It was thought that if a child was affected with cancer, the parents would likely be informed from the process of diagnosis and health management. By collecting

cancer reported between adults, it can be postulated that disparities in cancer reporting may be due to communication barriers.

How people feel about sharing cancer health information within the family varies. People choose to share cancer history for reasons such as to obtain emotional support, make others aware of their potential health risk, and obtain medical advice (Hughes et al. 2001). People may choose not to share for multiple reasons. Peters et al. observed three themes of why people chose not to discuss health information: 1. Social situation was not appropriate, 2. Beliefs, attitudes, knowledge, and family traditions and 3. protectiveness and privacy (Peters et al. 2011). Some examples include that holidays are not considered appropriate times to discuss cancer, some people are distrustful of the healthcare system, some feel the information is too personal to share, and some don't want to emotionally burden their relatives. Many research participants in studies of communication of genetic cancer risk are Caucasian and less is known about the material or lack of the communication in other ethnicities (Etchegary et al. 2013).

For minority populations, communication barriers may include negative stigma, lost family history, and low health literacy.

One study explored the communication of breast cancer testing and screening in the Latino community. A blocker of communication identified was the negative stigma that is associated with a cancer diagnosis. The Latino focus group reported that a cancer diagnosis was associated with shame and secrecy (Kinney et al. 2010). This outlook may cause communication barriers to other family members. Chinese Americans have also expressed a negative stigma associated with cancer. Quotes from a study analyzing barriers to cancer screening suggest that

Chinese Americans present themselves as “healthy” and that Chinese Americans “do not want others to know about [breast cancer],” (Simon, Tom, and Dong 2016).

Geographical location and not being in contact with relatives has been a communication barrier when studying the dissemination of cancer risks. (MacDonald et al., 2007 and McGivern et al. 2004). The populations from these studies were largely non-Hispanic, however, this barrier may be relevant for other ethnicities. For example, Hispanics and Asians who have first and second-degree family members in other countries may not be in contact due to geographical location or language differences. Geographic location could affect communication about cancer diagnoses more so in Hispanics and Asians compared to non-Hispanic Whites due to migration or different spoken languages. This may result in a reduction of cancer reporting from Hispanics and Asians.

Not understanding what health information is important to share with family members may be described as one component of lower health literacy (LHL). LHL was associated with Latino and African American populations in a paper that reviewed health literacy in American adults (Kutner et al. 2006). Another study analyzing dissemination of cancer information observed that physicians and Cancer Information Specialists (CIS) reported that low literacy was a barrier when communicating about cancer to Latino patients (Kaplan et al. 2016). Health literacy includes understanding the benefits of sharing cancer history within one’s family. If patients are unaware of the benefits, they may choose not to share information, which creates another barrier of disseminating cancer occurrences within the family.

There may be additional barriers to cancer communication that can be revealed by studying minority populations. For example, the use of interpreters in counseling sessions may be a barrier of communication between the health professional and the proband. Also, known barriers of communication may be found to have more influence in minority populations when compared to non-Hispanics Whites who have been studied more fully.

If a genetic counselor or health care professional recognizes that cancer may be under-reported in families, there are several approaches they can take. First, they can further assess for communication barriers by asking follow-up questions about cancer such as whether they would be privy to cancer diagnoses in family members if it had occurred. If communication barriers exist, health care professionals may consider a family history as "truncated," which can be used as a qualification criterion for genetic testing. Health care professionals can also discuss the benefits of sharing a family history of cancer with the patient to help improve health literacy. Lastly, health care professionals may offer to assist with communication about cancer by disseminating information via family letters or general cancer information pamphlets in appropriate languages. Identifying ethnicities where cancer is reported less frequently raises awareness to health care professionals and therefore they can use appropriate strategies to provide optimum care in the presence of possible truncated family histories.

Demographic and Categorical Data

In addition to the frequency of cancer reporting, this study additionally analyzed descriptive demographic data and categorical data between ethnicities. Demographic data analyzed included gender and age. Categorical data analyzed included whether the proband was affected or unaffected with cancer, if there was a positive family history, and the probands qualification status for BRCA1/2 genetic testing.

Gender Differences

Females were the majority of probands in all ethnicities. Males were represented as a smaller proportion in all (Figure 3). There are multiple reasons why women may be more represented. First, cancers that elicit a referral to cancer genetics such as breast and ovarian are more likely or only occur in women. Secondly, women have been known as "gatekeepers" for genetic health information and therefore may be more likely to attend genetic counseling (Gaff and Bylund 2010). Types of cancer and societal gender roles may contribute to the higher proportion of females seen in all ethnicities. Although females were more represented in both ethnicities, there were significantly less males in the Hispanic population when compared to non-Hispanic Whites. Multiple factors may contribute to the reduced presence of Hispanic males in the cancer genetic counseling demographics. One possible explanation could be the gender role of women as "gatekeepers" of health information is a stronger tradition in Hispanics

and therefore Hispanics may feel that obtaining genetic information is more of a women's domain. Also, there have been observed screening differences between non-Hispanic Whites and Hispanics that could reduce the chances of Hispanics, especially Hispanic males, from receiving a referral to genetic counseling. According to the National Health Interview Survey (NHIS), Hispanics in general are less likely to participate in colonoscopies compared to non-Hispanic Whites (White et al. 2015). Additionally, a study analyzing screening practices within Hispanics observed that females received colonoscopies more frequently than men; 62% compared to 42% (Miranda-Diaz et al. 2015). If Hispanic men participate in screening less often, then this could decrease their chances of receiving a referral to genetics for hereditary cancer syndromes and may explain the disparity seen in this study. Lastly, Hispanic men may have less ability to attend medical appointments such as inability to take time off work. This study was not able to decipher if Hispanic males did not get a referral to genetic counseling, if they did not accept the referral, or if they did not attend a scheduled appointment. Overall factors that contribute to this disparity is an area for further research.

Age Differences

Age ranges for probands were similar for all ethnicities spanning from the twenties to eighties. However, there was a significant difference seen between the non-Hispanic Whites and Hispanics. In general, non-Hispanic Whites were older than Hispanics with an average age of 57 compared to 52 respectively. What this data suggests is that Hispanics may be diagnosed with

cancer at younger ages compared to non-Hispanic Whites. One study looked at incidence in breast cancer by age and noticed an increasing gap of breast cancer rates between non-Hispanic Whites and Hispanics with increasing age. The ratio of Hispanics to non-Hispanic Whites with a new breast cancer diagnosis decreased with increasing age (Joslyn et al. 2005). In general, for all cancers, the SEER database observes a widening gap with increasing age in cancer incidence rates between non-Hispanic Whites and Hispanics. Again, the trend demonstrates the ratio of Hispanics to non-Hispanic Whites and cancer incidence decreases with increasing age (seer.cancer.gov). See Figure 9 for data trends and ages comparing non-Hispanic Whites and Hispanics.

Another possibility is that older Hispanics with cancer are under-referred in comparison to older non-Hispanic Whites. Reasons that might explain the age difference in this study could be that older non-Hispanic Whites are more likely to attend cancer screening compared to older Hispanics. In a study analyzing the disparities in colorectal cancer screening, it was noted in the demographics for age group 50-59-year-olds, Hispanics participated in screening more frequently than non-Hispanic Whites. The opposite was true for ages 65 and above; non-Hispanic Whites were more likely to participate in colorectal screening in the oldest age groups (Jerant et al. 2008). Either diagnosis or screening may elicit a referral to cancer genetic counseling. SEER incidence rates and screening behaviors associated with age may attribute to the significant age difference between distributions of non-Hispanic Whites and Hispanics seen in this study. Other factors may additionally exist that contribute to the significant age difference observed between non-Hispanic Whites and Hispanics.

Cancer sites include invasive cases only unless otherwise noted.
 Hispanics and Non-Hispanics are not mutually exclusive from whites, blacks, Asian/Pacific Islanders, and American Indians/Alaska Natives.

Figure 9: SEER Incidence Data by Age, non-Hispanic Whites and Hispanics

Categorical Data

Overall, the proportion of people who sought out genetic counseling who were affected with cancer was greater than those who were unaffected by cancer for non-Hispanic Whites, Hispanics, and Asians. Because data was collected from a high-risk clinic, the greater proportion of affected individuals compared to unaffected is not astounding. There was a significant difference in the proportions of Ashkenazi Jews who sought out genetic counseling who were not personally affected with cancer compared to the proportions from the Hispanics and Asians. This was not surprising considering approximately 2% of Ashkenazi Jews carry a mutation in BRCA1/2 that increases risk for certain cancers (Roa et al. 1996). Furthermore, all Ashkenazi Jewish families observed in this study reported at least one or more affected relatives. Having a close relative affected with cancer can elicit a referral to genetic counseling because the family history can increase one's own risk for the same cancer (Hemminki et al. 2007). Whether Ashkenazi Jews were aware of the familial effect of cancer is unknown, however a known family history of cancer can elicit a referral to genetic counseling. This observed significant finding may be partly explained by the widespread information available that Ashkenazi Jews are at an increased risk to carry mutations in BRCA1/2 and therefore may attend a genetic counseling session to inquire about their carrier status especially in combination with a positive family history.

The probands who were affected with a personal history of cancer were further analyzed whether they reported a negative or positive family history of cancer. The proportion of affected non-Hispanic Whites that reported a family history of cancer was significantly greater

than the proportion of affected Hispanics and Asians who reported a family history. About 96% of affected non-Hispanic White probands reported a positive family history compared to 77% and 73% of affected Hispanic and Asian probands respectively. This disparity seen in the minority ethnicities may be due to reduced incidence along with other communication barriers previously mentioned. Since cancer was not reported in 23% and 27% of Hispanic and Asian families respectively, this may suggest that communication barriers about cancer are more pervasive in these cultures compared to non-Hispanic Whites who reported cancer in all but 4% of families (Figure 7).

It was observed that the proportion of Ashkenazi Jews who qualified for BRCA1/2 testing based on family history was significantly higher compared to all three other ethnicities analyzed; non-Hispanic White, Hispanic, and Asian (Figure 8). Being of Ashkenazi Jewish descent increases eligibility for BRCA1/2 testing. For this study, being of Ashkenazi Jewish descent was a criterion included as "family history." Therefore, this observed significant finding was expected considering eligibility for BRCA1/2 testing increases with Ashkenazi Jewish ancestry.

Interestingly, this comparison did not find a significant difference in the proportion of individuals between the non-Hispanic White, Hispanic, and Asian ethnic groups that qualified based on family history. Therefore, this may suggest there is not a disparity regarding genetic testing qualification based on the NCCN guidelines between these ethnicities. Non-Hispanic Whites qualified more often than Hispanic and Asians for BRCA1/2 testing based on family history, however there was not a significant difference. Because non-Hispanic Whites report a family history more frequently than Hispanics and Asians, it was expected that non-Hispanic Whites would qualify for BRCA1/2 genetic testing more often based on category (b). Even

though the increase was not significant, it is worth mentioning that families included in this study presented to genetic counseling for all cancers, not limited to cancers associated with BRCA1/2 including breast, ovarian, pancreatic, and prostate cancers. An area for further evaluation would be to limit family inclusion for this comparison based on the indication of BRCA1/2 associated cancers and then analyze the proportion of individuals who qualified based on personal history, family history and those who do not qualify. Even though the BRCA1/2 results were not significant between non-Hispanic Whites and minorities, the method to compare families could be further optimized.

There are multiple factors that could have affected cancer reporting that were not accounted for while collecting information for this study. For example, cancer incidence rates are different in other countries. Probands or their family members who recently migrated to the United States may have a lower risk for cancer and therefore a lower reporting rate would be expected. The GLOBOCAN project is an entity of the World Health Organization that estimates cancer statistics worldwide. Data from GLOBOCAN 2012 states cancer incidence per 100,000 is less in Central and South America along with Asian countries compared to North American and European countries (Torre et al, 2015). Information about residency in the United States is not collected in a counseling session. Therefore, it is unknown if families were recent migrants, which if so, the number of expected family members to be reported with cancer would be lower than what is reflected from CDC data. Additionally, cancer reporting may have been lost in translation if interpreters were used, adding to the disparity in cancer reporting. Also, even though primarily one genetic counselor was drawing pedigrees during this two-year period along with students under her supervision, a counselor may not be consistent with information

documented over a two-year period. However, if the methods for collecting information varied, it would be expected that it affected ethnicities equally. There are many confounding factors that could have contributed to the disparity in cancer reporting seen in this study. Areas for additional analysis could include length of residency in the United States and use of interpreters to determine if either has a significant effect on cancer reporting in family histories.

Conclusion

Cancer among relatives is reported less frequently when the proband is of Hispanic or Asian ethnicity. Although these ethnicities have a lower incidence of cancer compared to non-Hispanic Whites, the disparity in reporting is greater than the disparity seen in the CDC incidence data. Therefore, it appears incidence rates do not fully explain the reporting disparity. How much of the observed differences in reporting family history of cancer are due to differences in actual cancer frequency or differences in communication patterns is uncertain. Possible explanations for the reduced cancer reporting include negative stigma associated with cancer, lost family history from migration or language barriers, or lower health literacy. The disparity in cancer reporting suggests that family histories of minority populations are truncated. There may be a need to educate minorities on the importance of sharing cancer history within their families if there appears to be barriers.

Education can allow patients to make educated decisions about communicating cancer history with family members and improve health literacy. Knowing one's family history of cancer is important to provide appropriate medical management for cancer screening and/or cancer genetic testing.

Appendix

Table 15: Terms and Definitions

<i>Terms and Definitions</i>	
<i>FDR</i>	First Degree Relative
<i>SDR</i>	Second Degree Relative
<i>BRCA1/2</i>	Breast cancer genes 1 and 2
<i>Non-Hispanic White</i>	Non-Hispanic, non-Ashkenazi Jewish Whites
<i>HBOC</i>	Hereditary Breast and Ovarian Cancer
<i>AJ</i>	Ashkenazi Jewish
<i>Proband</i>	Person in the family who initially brings the family to medical attention for being affected or at risk for the condition being examined.
<i>Affected</i>	Documented or reported to have a cancer defined as a malignant neoplasm
<i>Proband</i>	Patient scheduled for genetic counseling, or the person that brings a family to medical attention
<i>No Family History</i>	Patient did not report a family member to be affected with cancer.
<i>Positive Family History</i>	Patient reported at least 1 or more family members affected with cancer.
<i>NCCN</i>	National Comprehensive Cancer Network
<i>CDC</i>	Center for Disease Control

Table 16: List of Inclusion and Exclusion Criteria for Assigning Ancestry.

Ancestry	
<i>Include</i>	<i>Exclude</i>
<ul style="list-style-type: none"> • If there was a "?" next to ancestry reported, then accounted for ancestry even though it is questionable. For example, if ancestry was listed as "French?" it was included in the non-Hispanic White ethnicity. • If there was a "?" for ancestry on one side of the family with no ethnicity reported, and if ancestry was reported for the other side of family, the ancestry that was reported for the one side was accounted as majority. * • Spanish ancestry was counted as either Hispanic or non-Hispanic White depending on other ancestry reported. (i.e. Spanish with Mexican ancestry, accounted as Hispanic. Spanish with English ancestry accounted as White.) • Justification: These rules allowed for the inclusion of pedigrees when ancestry was not well defined but still aligned into one of the ethnic groupings. 	<ul style="list-style-type: none"> • Ancestry that did not fall into one of the following categories listed in the CaGen Database: non-Hispanic White, Hispanic, Asian, African American, Ashkenazi Jewish. • Pedigrees where the predominant ancestry was different on maternal and paternal sides of the family. • Justification: These pedigrees were not included because the mixture of ethnicity may dilute either ethnic backgrounds habits of reporting cancer in family members if there is a difference in reporting behavior.
*example in Figure 10	

Table 17: List of Inclusion and Exclusion Criteria for Accounting for First and Second-Degree Relatives Over Age 18

Accounting for First and Second-Degree Relatives > 18 years old	
<i>Include</i>	<i>Exclude</i>
<ul style="list-style-type: none"> Unknown ages if reasonably over the age of 18 (i.e. aunts and uncles where the generation ages are 40s or 50s) Unknown sex of FDR or SDR, count as 1 male FDR or SDR respectively. Because the family member is known, they should be accounted for. For the study, it did not affect data analysis if the relative was accounted as male or female. * N inside diamond: 1 male* N inside square: 1 male* N inside circle: 1 female* N is a symbol for "at least one or more relatives" for the corresponding relation on the pedigree. Because at least one relative is thought to exist, then accounted for only one relative Square, circle, or diamond with question mark, count as 1 relative of sex indicated. Treated the same as an "N." If there was a circle and a square identifying one individual: accounted for as male relative. The symbol possibly accounted for sex change or mistake in sex of relative. The relative should be accounted for because they were reported, and sex documented did not change data analysis. 	<ul style="list-style-type: none"> "# nieces and nephews" not accounted for unless they could be reasonably argued to be above the age of 18 years old. For example, if the niece or nephew was the child of an 80-year-old woman, then they would reasonably be above the age of 18 due to logistical pregnancy ages of women. If nieces and nephews did not have ages listed and they were from a mother in her 40s, then they could realistically be under the age of 18 and were therefore excluded. If no symbols were drawn, then excluded from counting, even if obligatory relatives exist (i.e. grandparents) If relative's age is not documented and they can arguably be <18 years old, then excluded in count of first and second-degree relatives. If a symbol was labeled "died in teens," then did not account for as a relative > 18
*example in Figure 10	

Table 18: List of Inclusion and Exclusion When Accounting for Cancer in Proband and Relatives

Accounting for Cancer in Proband and Relatives	
<i>Include</i>	<i>Exclude</i>
<ul style="list-style-type: none"> • If cancer was reported but type was unknown, it was included as a reported cancer. • If an individual was affected with multiple cancer types, they were accounted as one affected relative reported • If cancer was reported but cancer type was labeled as unknown or "?," accounted as affected relative with unknown cancer • If symbol of an individual was not shaded, but cancer was written under it, include as affected relative reported and include type of cancer. • Account a relative as affected if their corresponding symbol is shaded, even if no cancer type was documented under their symbol. • If unclear what relatives were affected due to illegibility of pedigree, may use summary page on CaGen to clarify which relative was affected and with what type of cancer. • "Possible X cancer" counted as an affected relative reported with unknown cancer. • "Brain Met" accounted as relative reported with brain cancer. 	<ul style="list-style-type: none"> • If cancer was reported with a "?" next to it, not accounted as affected relative, even if symbol is shaded. • If symbol was labeled as "possible cancer," then relative not accounted for having a reported cancer. • Polyps not counted as cancer. • First degree and second degree relative with cancer diagnosis below the age of 18 not accounted as affected relative because the cancer was diagnosed under the age of 18. • Relatives labeled as having a "pre-cancerous" growth were not counted as affected. • If symbol is shaded, but clearly states "no cancer" below, then relative not included as being affected. • A symbol was labeled as: "low malignant potential borderline tumor of the ovary," and not accounted as affected relative. • If symbol was not shaded and cancer was written as unknown or question mark, then relative was not accounted as reportedly affected. • Benign tumor for both proband and relative were not accounted as reportedly affected. Because tumors were known to be benign, this may change one's cultural perspective regarding stigma toward cancer and therefore be more willing to report. • Uterine fibroid, even if symbol was shaded, did not qualify a relative as affected. Fibroids are not considered malignant neoplasms.

Table 19: List of Inclusion and Exclusion Criteria for BRCA1/2 Qualification

BRCA 1/2 Qualifications	
<i>Include</i>	<i>Exclude</i>
<ul style="list-style-type: none"> When qualifying for BRCA1/2 testing criteria, assume high Gleason score for individual and family members with prostate cancer. Gleason scores may not be known and are not listed on the pedigrees. Because the purpose is to assess if cancer is being reported, the details of Gleason Score were not considered as added value. Because NCCN guidelines includes information from third degree relatives, that relation was included to assess qualification for BRCA1/2 testing. 	<ul style="list-style-type: none"> The NCCN guidelines states that one may qualify for BRCA1/2 testing if there is "an unknown or limited family history." This criterion was note taken into consideration for qualifying because it is subjective, and it was not documented on pedigree if there is an unknown of limited family history.

Figure 10: Examples of Pedigree Symbols and Information

Table 20: Calculations to Derive Expected Number of Relatives Reported for Hispanics and Asians Based on CDC Incidence Data in Proportion to non-Hispanic Whites.

	<i>Non-Hispanic Whites</i>	<i>Hispanics</i>	<i>Asians</i>
<i>Collective</i>			
<i>Total Relatives Reported with Cancer (Observed in Current Study))</i>	704	322	196
<i>Total Relatives Reported (Current Study)</i>	3191	3096	1743
<i>% of Reporting</i>	704/3191 22.06%	322/3096 10.4%	196/1743 11.2%
<i>CDC Average for Male and Female Cancer Incidence Rate per 100,000*</i>	443.4	342.4	279.7
<i>% of non-Hispanic White Incidence</i>	443.4/443.4 100%	342.4/443.4 77.2%	279.7/443.4 63.1%
<i>Expected Percent of Relatives Reported Based on Incidence Rates and Percentage Reported by non-Hispanics Whites in Current Study</i>	(fixed) 22.06%	(77.2% of 22.06%) 17.03%	(63.1% of 22.06%) 13.92%
<i>Expected # of Relatives Reported with Cancer Based on Population Incidence Differences</i>	(fixed) N/A	3096*17.03% =527.38	1743*13.92% =242.57

*Collective: Combined relatives from all families per ethnicity
Bolded numbers used for chi-square comparison (Table 14)*

**CDC.gov*

Figure 11: CDC Male Incidence Rate of Cancer by Ethnicity (CDC.gov)

Figure 12: CDC Female Incidence Rate of Cancer by Ethnicity (CDC.gov)

References

- CDC – Cancer Rates by Race/Ethnicity and Sex. Center for Disease Control Web site. <https://www.cdc.gov/cancer/dcpc/data/race.htm> 2018. Accessed May 13, 2018.
- Etchegary H, Potter B, Perrier C, Wilson B. Cultural differences in family communication about inherited cancer: implications for cancer genetics research. *J Cult Divers*. 2013;20(4):195-201.
- Genetics. National Cancer Institute Web site. <https://www.cancer.gov/about-cancer/causes-prevention/genetics> 2018. Accessed May, 12, 2018.
- Gaff CL, Bylund CL. *Family Communication About Genetics: Theory and Practice*. New York: Oxford University Press Inc; 2010.
- Hampel H, Bennett RL, Buchanan A, Pearlman R, Wiesner GL, Guideline Development Group AeCoMGaGPPaGCaNSoGCPGC. A practice guideline from the American College of Medical Genetics and Genomics and the National Society of Genetic Counselors: referral indications for cancer predisposition assessment. *Genet Med*. 2015;17(1):70-87.
- Hemminki K, Sundquist J, Bermejo JL. How common is familial cancer? *Ann Oncol*. 2008;19(1):163-167.
- Hughes C, Lerman C, Schwartz M, et al. All in the family: evaluation of the process and content of sisters' communication about BRCA1 and BRCA2 genetic test results. *Am J Med Genet*. 2002;107(2):143-150.
- Jerant AF, Fenton JJ, Franks P. Determinants of racial/ethnic colorectal cancer screening disparities. *Arch Intern Med*. 2008;168(12):1317-1324.
- Joslyn SA, Foote ML, Nasser K, Coughlin SS, Howe HL. Racial and ethnic disparities in breast cancer rates by age: NAACCR Breast Cancer Project. *Breast Cancer Res Treat*. 2005;92(2):97-105.
- Jun J, Nan X. Determinants of Cancer Screening Disparities Among Asian Americans: A Systematic Review of Public Health Surveys. *J Cancer Educ*. 2017.
- Kaplan CP, Nápoles A, Davis S, et al. Latinos and Cancer Information: Perspectives of Patients, Health Professionals and Telephone Cancer Information Specialists. *J Health Dispar Res Pract*. 2016;9(2):154-167.
- Kinney AY, Gammon A, Coxworth J, Simonsen SE, Arce-Laretta M. Exploring attitudes, beliefs, and communication preferences of Latino community members regarding BRCA1/2 mutation testing and preventive strategies. *Genet Med*. 2010;12(2):105-115.
- Kutner M, Greenburg E, Jin Y, Paulsen C. *The Health Literacy of America's Adults: Results from the 2003 National Assessment of Adult Literacy*. NCES 2006-483. U S Department of Education. Washington DC: National Center for Education Statistics; 2006.

- Lu KH, Wood ME, Daniels M, et al. American Society of Clinical Oncology Expert Statement: collection and use of a cancer family history for oncology providers. *J Clin Oncol*. 2014;32(8):833-840.
- MacDonald DJ, Sarna L, van Servellen G, Bastani R, Giger JN, Weitzel JN. Selection of family members for communication of cancer risk and barriers to this communication before and after genetic cancer risk assessment. *Genet Med*. 2007;9(5):275-282.
- McGivern B, Everett J, Yager GG, Baumiller RC, Hafertepen A, Saal HM. Family communication about positive BRCA1 and BRCA2 genetic test results. *Genet Med*. 2004;6(6):503-509.
- Miranda-Diaz C, Betancourt E, Ruiz-Candelaria Y, Hunter-Mellado RF. Barriers for Compliance to Breast, Colorectal, and Cervical Screening Cancer Tests among Hispanic Patients. *Int J Environ Res Public Health*. 2015;13(1):ijerph13010021.
- NCCN - Evidence-Based Cancer Guidelines, Oncology Drug Compendium, Oncology Continuing Medical Education. <https://www.nccn.org> 2018. May 26, 2018.
- NCCN - Genetic/Familial High Risk Assessment: Breast and Ovarian Cancer. National Comprehensive Cancer Network Web Site. https://www.nccn.org/professionals/physician_gls/pdf/genetics_screening.pdf Published October 3, 2017. Accessed May 12, 2018.
- NIH – Genetics. National Cancer Institute Web site. <https://www.cancer.gov/about-cancer/causes-prevention/genetics> 2018. Accessed May 26, 2018.
- Pagán JA, Su D, Li L, Armstrong K, Asch DA. Racial and ethnic disparities in awareness of genetic testing for cancer risk. *Am J Prev Med*. 2009;37(6):524-530.
- Peters JA, Kenen R, Hoskins LM, et al. Unpacking the blockers: understanding perceptions and social constraints of health communication in hereditary breast ovarian cancer (HBOC) susceptibility families. *J Genet Couns*. 2011;20(5):450-464.
- Ponce NA, Tsui J, Knight SJ, et al. Disparities in cancer screening in individuals with a family history of breast or colorectal cancer. *Cancer*. 2012;118(6):1656-1663.
- Roa BB, Boyd AA, Volcik K, Richards CS. Ashkenazi Jewish population frequencies for common mutations in BRCA1 and BRCA2. *Nat Genet*. 1996;14(2):185-187.
- Sadler GR, Nguyen F, Doan Q, Au H, Thomas AG. Strategies for reaching Asian Americans with health information. *Am J Prev Med*. 1998;14(3):224-228.
- Schneider K. Counseling About Cancer, Strategies for Genetic Counseling. Dana-Farber Cancer Institute: Wiley-Blackwell; 2012.
- Seer.cancer.gov. Fast Stats. National Institute of Health Web site. <https://seer.cancer.gov/faststats/selections.php?#Output> 2018 Accessed 19 May 2018.

- Simon MA, Tom LS, Dong X. Breast Cancer Screening Beliefs Among Older Chinese Women in Chicago's Chinatown. *J Gerontol A Biol Sci Med Sci*. 2017;72(suppl_1):S32-S40.
- Torre LA, Bray F, Siegel RL, Ferlay J, Lortet-Tieulent J, Jemal A. Global cancer statistics, 2012. *CA Cancer J Clin*. 2015;65(2):87-108.
- Tsoh JY, Sentell T, Gildengorin G, et al. Healthcare Communication Barriers and Self-Rated Health in Older Chinese American Immigrants. *J Community Health*. 2016;41(4):741-752.
- Valdovinos C, Penedo FJ, Isasi CR, et al. Perceived discrimination and cancer screening behaviors in US Hispanics: the Hispanic Community Health Study/Study of Latinos Sociocultural Ancillary Study. *Cancer Causes Control*. 2016;27(1):27-37.
- White A, Thompson TD, White MC, et al. Cancer Screening Test Use - United States, 2015. *MMWR Morb Mortal Wkly Rep*. 2017;66(8):201-206.